FINAL
THIRD FIVE-YEAR REVIEW REPORT

for

Umatilla Chemical Depot

Hermiston

Umatilla and Morrow Counties, Oregon

11 March 2010

PREPARED BY:

US Army Corps
of Engineers®
Seattle District

LEAD AGENCY SIGNATURE
THIRD FIVE-YEAR REVIEW
UMATILLA CHEMICAL DEPOT

This signature sheet documents the United States Army acceptance of the third Five-Year Review for the Umatilla Chemical Depot.

Kris N. Perkins
Lieutenant Colonel, US Army
Commanding

15 MAR 10
DATE

SUPPORT AGENCY SIGNATURE
THIRD FIVE-YEAR REVIEW
UMATILLA CHEMICAL DEPOT

This signature sheet documents the United States Environmental Protection Agency concurrence with the third Five-Year Review for the Umatilla Chemical Depot.

Daniel D. Opalski, Director
Office of Environmental Cleanup
U.S. EPA Region 10

7/30/2010
DATE

SUPPORT AGENCY SIGNATURE
THIRD FIVE-YEAR REVIEW
UMATILLA CHEMICAL DEPOT

This signature sheet documents the State of Oregon concurrence with the third Five-Year Review for the Umatilla Chemical Depot.

D. Mitch Wolgamott — 7 APR 10

Mitch Wolgamott
Eastern Region Division Administrator
ODEQ

DATE

FIVE-YEAR REVIEW REPORT

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Acronyms and Abbreviations

°F	Degrees Fahrenheit
µg/L	Micrograms per liter
ADA	Ammunition Demolition Activity
AMC	Army Materiel Command
ARAR	Applicable, or Relevant and Appropriate Requirement
BRAC	Base Realignment and Closure
BRACD	Base Realignment and Closure Division
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CGA	Critical Groundwater Area
CMA	Chemical Materials Agency
DRMO	Defense Reutilization Marketing Office
EPA	United States Environmental Protection Agency
ERDC	Engineer Research and Development Center
ESD	Explanation of Significant Differences
EWL	Explosives Washout Lagoons
FFA	Federal Facilities Agreement
FS	Feasibility Study
FYR	Five-Year Review
GAC	Granular activated carbon
gpm	Gallons per minute
HA	Health Advisory
IC	Institutional Control
IRIS	Integrated Risk Information System
MCL	Maximum Contaminant Level
MEC	Munitions and explosives of concern
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
N/A	Not applicable
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
ODEQ	Oregon Department of Environmental Quality
OSWER	Office of Solid Waste Emergency Response
OU	Operable Unit

P&T	Pump and Treat
PA/SI	Preliminary Assessment/Site Investigation
PLC	Programmable Logic Controller
PQL	Practical Quantitation Limit
QA	Quality Assurance
RA	Remedial Action
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
RI	Remedial Investigation
ROD	Record of Decision
S/S	Solidification/ Stabilization
TCLP	Toxicity Characteristic Leaching Procedure
TNT	2,4,6-Trinitrotoluene
UMCD	Umatilla Chemical Depot
USACE	United States Army Corps of Engineers
VOC	Volatile organic compound
WES	Waterways Experiment Station
Y/N	Yes/ No

Executive Summary

This third Five-Year Review covers selected remedies for Operable Units (OUs) at Umatilla Chemical Depot that were recommended for further reviews in the second Five-Year Review in 2004, as well as those OUs where subsequent reviews were not required but where there were changes since the 2004 review.

The Explosives Washout Lagoons Groundwater OU and the Ammunition Demolition Activity OU both encompass remedial actions which resulted in hazardous substances remaining on site above levels that allow for unlimited use and unrestricted exposure. The Miscellaneous Sites OU (including Site 39) and the Landfill OU, although determined not to fall within the purview of Five-Year Review reporting, are addressed in this review because of changes or updates regarding those OUs since 2004.

Based on review of available reporting and data since 2004, all remedies covered under this UMCD Five-Year Review remain protective of human health and environment in the short-term. The remedial systems are operating and functioning as designed, although for the groundwater extraction and treatment system at the Explosives Washout Lagoons Groundwater OU, changes to system operation are being implemented in an attempt to make the system more efficient.

The next five year review will be completed by September 2014. Future Five-Year Reviews are necessary at the Explosives Washout Lagoons Groundwater OU and the Ammunition Demolition Activity (ADA) OU, because contamination remains above levels that allow for unrestricted use and unlimited exposure. An update on the status of the Landfill OU may also be included in the next five year review, due to changes at that OU.

Five-Year Review Summary Form

SITE IDENTIFICATION		
EPA ID *(from WasteLAN)*: OR6213820917		
Region: 10	**State: OR**	**City/County: Hermiston / Morrow & Umatilla**
SITE STATUS		
NPL status: Final on the NPL		
Remediation status: Operating		
Multiple OUs? YES	**Construction completion date:** To Be Determined/Unknown	
Has site been put into reuse? NO		
REVIEW STATUS		
Lead agency: U.S. Army		
Author/Organization: US Army Corps of Engineers		
Review period: October 2004 to September 2009		
Date of site inspection: 08/19/2009		
Type of review: Post-SARA		
Review number: 3 (third)		
Triggering action: Previous Five-Year Review Report		
Triggering action date: 09/30/2004		
Due date: 09/30/2009		

Five-Year Review Summary Form, cont'd.

Issues:

1. (EWL Groundwater OU). Treatment system in continuous operation mode has become less effective at removing contaminant mass and reducing contaminant concentrations. System is currently operating under a pulse-pump mode to evaluate if this technique can either be more effective at removing mass and/or if it can shorten the cleanup time frame. A groundwater model is currently under development by USACE-ERDC and will be used to assist the UMCD team with decision making scenarios for the EWL groundwater, including appropriate pulse-pumping periods, additional extraction well installation, bioremediation scenarios, and impacts of discontinuing the pump and treat system.

2. (EWL Groundwater OU). Conflicting RDX plume containment information. Plume containment appears to be more certain based on recent data and ERDC groundwater modeling when compared to previously published results of five-year capture zone modeling.

3. (Landfill OU). Landfill OU groundwater monitoring has continued well beyond four-year post-closure requirement with no evidence of release. Consider eliminating or reducing monitoring requirements. Nitrate and selenium are elevated, however, as long as controls are maintained to prevent groundwater use, the exposure pathway is incomplete. ODEQ Staff Report/ROD cleanup plan has not been accepted by the Army or finalized.

4. (ADA OU). Disposal trenches that are believed to contain munitions and explosives of concern have not been fully characterized or remediated. Phase II MEC clearance has not occurred. Current access restrictions are adequate to maintain protectiveness until final remedial actions are selected and implemented; however these restrictions will require inspection and maintenance until final remedial actions are in place.

5. (ADA OU). Although regionally elevated groundwater arsenic concentrations were below the MCL at the time the ROD was issued, the reduction of the MCL from 50 to 10 µg/l in 2007 now means levels are likely above the MCL.

Recommendations and Follow-up Actions:

1. (EWL GW OU). Evaluate pulse-pump mode of operation and evaluate groundwater model results with respect to pulse-pumping; if ineffective consider alternate means of optimization/ enhancement, including pilot bioremediation testing.

2. (EWL GW OU). Plume containment. Reevaluate by running and formally documenting five-year capture zone analysis using latest groundwater model to demonstrate RDX plume containment, particularly in eastern lobe. As part of this effort, regression analysis will be used to predict the time frame for RDX levels in eastern lobe groundwater to drop below the regulatory level.

3. (Landfill OU). Finalize ODEQ Staff Report/ROD cleanup plan, determine whether remedy remains protective and if so, eliminate or reduce groundwater monitoring requirement.

4. (ADA OU). Once an agreement has been reached on land reuse, Phase II subsurface MEC clearance activities will be performed within 15 months as per ROD.

5. (ADA OU). Recommend sampling select wells that have historically had arsenic above 10 µg/l, and to assess impacts on future land use and ICs once funding becomes available to do so, and before next Five-Year Review.

Protectiveness Statements:

EWL GW OU: The remedy is operating and is expected to be protective upon completion; in the interim, prohibition on the use of groundwater will be required to ensure short-term protectiveness. All exposure pathways that could result in unacceptable risks are currently being controlled.

ADA OU: The remedy at the ADA OU is protective of human health and the environment in the short-term because controls are in place to prevent exposure to the remaining MEC and exposure to arsenic in groundwater by prohibiting usage; however, to be protective in the long term, additional actions are required. The future land use decision will dictate specifically what follow-on remedial action will be required, and updated groundwater sampling results will determine what land use controls must remain in place for the site to remain protective in the future.

Site 39: The remedy at Site 39 is protective of human health and the environment because all media preventing unlimited use and unrestricted exposure have been removed.

Landfill OU: The remedy at the Landfill OU currently protects human health and the environment because all known Landfill-related contaminants of concern with the possible exception of selenium which pose risk are below regulatory levels and because, although selenium in groundwater is elevated, there is currently no complete exposure pathway for groundwater. However, for the remedy to be protective in the long-term, deed restrictions may be required preventing use of groundwater resources within and downgradient of the elevated selenium area once the property is transferred from Army ownership.

Other Comments: None.

Umatilla Chemical Depot
Hermiston, Umatilla and Morrow Counties, Oregon
Third Five-Year Review

I. Introduction

Purpose

The purpose of a Five-Year Review is to determine whether the remedy at a site which has not yet been closed out is protective of human health and the environment. The methods, findings, issues, recommendations, and conclusions of reviews are documented in the Five-Year Review reports. There are a total of eight Operable Units (OUs) at Umatilla Chemical Depot (UMCD), several of which are considered still active under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA); therefore, the goal of this third UMCD Five-Year Review is to determine whether the remedial actions selected for each of these sites remain protective and are functioning as designed. The start of remedial-related construction at the Washout Lagoons Soils OU in June 1994 triggered the first Five-Year Review, which was completed in September 1999. At least once each five years the site must be reviewed under CERCLA authority and guidance to re-evaluate protectiveness. The second Five-Year Review was completed in September 2004. The scope of this review covers selected remedies for the OUs recommended for further Five-Year Reviews in 2004, as well as those OUs where subsequent Five-Year Reviews were not required but where changes occurred since the last review.

Authority Statement

The United States Army (Army) has conducted this review pursuant to CERCLA §121, 42 USC 962 1(c), the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) – 40 CFR 300.430(f)(4)(ii), Executive Order 12580 (January 23, 1987), and Section 19.1 of the Federal Facilities Agreement (FFA) for Umatilla Army Depot dated October 31, 1989.

CERCLA §121 states:

If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the

judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

The EPA interpreted this requirement further in the NCP; 40 CFR §300.430(f)(4)(ii) states:

If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.

This review document is consistent with OSWER Directive 9355.07-03B-P (June 2001). Consistent with the FFA, the project managers for EPA Region 10 and the Oregon Department of Environmental Quality (ODEQ) have participated in this review. This review is limited to only those sites being remediated under CERCLA authority.

Installation Sites Under CERCLA Authority

The UMCD OUs under CERCLA authority for which additional Five-Year Reviews are required are: Explosives Washout Lagoons Groundwater OU, Ammunition Demolition Activity (ADA) OU, Site 39 of Miscellaneous Sites OU, and the Landfill OU.

II. Site Chronology

The following table details the major milestones or notable events for the UMCD Site.

TABLE 1. CHRONOLOGY OF SITE EVENTS

Event	Date
Initial discovery of problem or contamination RCRA Facility Assessment and Initial RI	Discovery: May 1, 1980 PA/SI: December 1, 1982
NPL Listing	August 21, 1987
Federal Facility Agreement signature	October 31, 1989
Expanded Remedial Investigation/Feasibility Study conducted	1990 – 1993

Event	Date
ROD signatures	Lagoon Soils: September 25, 1992 Deactivation Furnace: December 31, 1992 Active Landfills; Inactive Landfills: August 10, 1993 Lagoon Groundwater; ADA; Washout Plant; Miscellaneous Sites: July 19, 1994 Site 39: May 2, 2005
ROD Amendments or ESDs	Explosive Washout Plant OU: August 28, 1995 Lagoon Soils: September 30, 1997 ADA Soils OU: June 27, 2002
Remedial design start	Lagoon Soils: February 25, 1993 Deactivation Furnace: February 25, 1993 Active Landfills; Inactive Landfills: N/A Lagoon Groundwater: September 12, 1994 ADA: September 2, 1994 Washout Plant: July 19, 1994 Miscellaneous Sites: September 2, 1994
Remedial design complete	Lagoon Soils: June 23, 1993 Deactivation Furnace: September 14, 1993 Active Landfills; Inactive Landfills: N/A Lagoon Groundwater: July 31, 1995 ADA Soils Tier 1: August 10, 1995 ADA Soils Tier 2: August 2002 Washout Plant: October 19, 1995 Miscellaneous Sites: August 10, 1995 Site 39: August 2008
Remedial action start	Lagoon Soils: September 23, 1993 Deactivation Furnace: October 26, 1993 Active Landfills; Inactive Landfills: N/A Lagoon Groundwater: December 30, 1995 ADA Soils Tier 1: September 30, 1995 ADA Soils Tier 2: January 8, 2002 Washout Plant: February 1, 1996 Miscellaneous Sites: November 6, 1995 Site 39: October 7, 2008

Event	Date
Construction dates (start/ finish)	Lagoon Soils: November 1993/ May 1997 Deactivation Furnace: November 1993/ December 1997 Active Landfills; Inactive Landfills: N/A Lagoon Groundwater: January 1996/ December 1996 ADA Soils Tier 1: November 1995/ April 2000 ADA Soils Tier 2: February 2002/ August 2003 Washout Plant: February 1996/ April 1998 Miscellaneous Sites: November 1995/ December 1997 Site 39: October 2008/ November 2008
Final Remedial Action Reports	Lagoon Soils: September 28, 2001 Deactivation Furnace: September 28, 2001 Active Landfills; Inactive Landfills: N/A Lagoon Groundwater: RA Ongoing ADA Soils: February 2005 Washout Plant: September 28, 2001 Miscellaneous Sites: September 28, 2001 Site 39: August 2009
Five-Year Review Report	First FYR: September 1999 Second FYR: October 2004
ODEQ Cleanup Program Remedial Action Recommendation Report	Landfill: March 2005 (Draft version)
Pulse-pumping optimization (start)	Lagoon Groundwater: February 2009

III. Background

Installation Description

Umatilla Chemical Depot (UMCD) is a 19,728-acre military reservation established in 1941 originally as an ordnance depot. The UMCD is located in northeastern Oregon in Umatilla and Morrow Counties. It is approximately five miles west of Hermiston, Oregon, and three and one-half miles south of the Columbia River (Figure 1).

The installation was placed on the Base Realignment and Closure (BRAC) list for realignment in 1988, and subsequently recommended for closure under BRAC 2005. The 2005 BRAC recommendation provides that the installation shall close when all

demilitarization activities are complete. BRAC 2005 states a preference for like reuse after closure – in this case industrial or like military reuse – as opposed to residential use; however, the Army's preferred reuse is not guaranteed and does not ultimately impact the cleanup criteria established for the remaining OUs. The current activities at the facility include remediation of CERCLA sites and demilitarization of nerve agents, blister agents, and chemical munitions under RCRA authorities.

Physical Site Characteristics

The installation lies within the Umatilla Lowlands of the Columbia Plateau and is surrounded primarily by irrigated agricultural land. The lowlands are bordered on the west by hills adjacent to the Cascade Range. The Horse Heaven Plateau borders the lowlands on the north while the Pendleton Plains mark the eastern boundary. Coyote Coulee is the most prominent site surface feature, cutting across the depot in a northeast trend. Average land surface elevation is 450 ft above mean sea level. No surface water bodies are present at UMCD. The regional climate is characterized as a semi-arid cold desert. Average annual precipitation is 8.85 inches, 60 percent of which occurs between November and March. Potential evapotranspiration is high, averaging 32 inches per year. Potential evapotranspiration is the theoretical amount of moisture that could be lost from land surface to the atmosphere if it were available. Actual evapotranspiration is much less than potential, and is approximately equal to the annual precipitation. Groundwater recharge is estimated at 0.5-inch per year. The average temperature is 74° F during the hottest month (July) and 32° F in the coldest month (January) (Western Regional Climate Center 2009).

Overburden soils at the facility typically consist of Quaternary silt, clay, and alluvial sand and gravel. Topography at the facility is relatively flat with some gently rolling hills or slopes. Vegetation is extremely sparse; the principal native vegetation is sage brush. A thin layer of windblown fine sands and silt from reworked glacial river deposits and volcanic sediments cover much of the land surface.

Groundwater occurs beneath the UMCD in a number of distinct hydrogeologic settings in a series of relatively deep confined basalt aquifers and in a highly productive permeable unconfined aquifer to the south of UMCD (extending off-post) referred to as the Ordnance Gravel. The unconfined aquifer at UMCD consists of the alluvial deposits and the weathered surface of the Elephant Mountain Member basalt, and is overlain by approximately 20 to 125 feet of unsaturated alluvial sand and gravel. Depth to groundwater ranges from 60 to 100 feet below ground surface. The saturated thickness of the alluvial aquifer, particularly in the area of the former explosives washout plant, is approximately 15 to 35 feet. The natural groundwater surface exhibits a very flat gradient and seasonal reversals in flow direction due to agricultural pumpage in the region. Three municipal water systems – that of Hermiston, Umatilla, and

Irrigon – draw from groundwater within a four-mile radius of UMCD. Approximately 1,500 wells were identified within this four-mile radius of UMCD, the majority of which are used for domestic and irrigation water. The Columbia River is a major source of potable and irrigation water as well in the region, and is also used for recreation, fishing, and the generation of hydroelectric power. The Umatilla River is located approximately 2 miles to the east of the eastern boundary of UMCD and is a tributary to the Columbia. The principal use of the Umatilla River is for irrigation. UMCD obtains its drinking water from clean groundwater resources outside the areas affected by contamination which are discussed in this report.

The Oregon Water Resources Department has designated four aquifers within the Umatilla Basin as Critical Groundwater Areas (CGAs) due to their documented overdraft. A significant portion of UMCD, including that of the Explosives Washout Lagoons Groundwater OU and the Landfill OU, lies within one of those CGAs known as the Ordnance Gravel aquifer. A shared future vision of local stakeholders as well as the State is to increase water availability in the CGAs. A feasibility study on the Umatilla Basin regional aquifer recovery was recently completed (IRZ 2009) which evaluated water diversions from the Columbia and Umatilla Rivers during high winter and spring flow periods and storage in the Ordnance Gravel aquifer for later use for irrigation as well as environmental benefits. Eventual execution of this plan will likely impact groundwater elevations and gradients at UMCD and will therefore likely present new challenges for the groundwater-related OUs on site.

Land Use and History of Contamination

Most hazardous waste activities at UMCD have been associated with munitions, including the disassembly, analysis, modification, reassembly, and repacking of conventional munitions and the storage of chemical munitions and containerized blister agents. Specific disposal operations included release of wastewater from the Explosives Washout Plant into two leaching beds; and various deactivation, demolition, burning, or burial sites for sewage treatment sludge, munitions, and scrap. UMCD also received a RCRA permit to incinerate toxic nerve agents, blister agents, and chemical-filled munitions. UMCD can not be closed until the chemical munitions demilitarization mission is completed. According to Umatilla BRAC Cleanup Plan, the RCRA-permitted demilitarization is expected to be completed by 2010, to be followed by depot closure and the beginning of transfer from Federal ownership in 2012.

Section IV presents additional detail concerning historical activities which led to OU-specific contamination at UMCD.

Initial Response

The Army completed the Initial Installation Assessment in 1980. The EPA RCRA Facility Assessment was later completed in 1987, which led to the NPL Listing in August 1987. Response actions did not occur until after the FFA was signed in October 1989. The Operable Unit response actions followed completion of RI/FS reports and ROD signatures in September 1992 through July 1994 (See Table 1, Chronology of Site Events).

Basis for Taking Remedial Action

Due to historical military-related activities on the site, environmental investigations were conducted in order to identify areas of concern, characterize site conditions, and to define the nature and extent of contamination. The basis for remedial action at this site is CERCLA, the NCP, and EPA policy and guidance implemented under the three-party (Army/EPA/ODEQ) Federal Facility Agreement for the UMCD.

Hazardous substances that have been released at UMCD and detected above background levels in each media where background levels are known, based on past investigations, include:

TABLE 2. HAZARDOUS SUBSTANCES DETECTED IN SOIL, UMCD

Metals	Aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, silver, thallium, zinc
Other inorganics	Nitrate/nitrite
VOCs	Xylenes
Chlorinated VOCs	Trichloroethylene
Explosives	1,3,5-TNB, 2,4,6-TNT, 2,4-DNT, 2,6-DNT, RDX, Tetryl, HMX, nitrobenzene
Pesticides	DDD, DDE, DDT, Dieldrin, Endrin
Other	Cyanide, MEC material

TABLE 3. HAZARDOUS SUBSTANCES DETECTED IN GROUNDWATER, UMCD

Metals	Arsenic
Other inorganics	Nitrate
Explosives	TNB, DNB, NB, TNT, 2,4-DNT, 2,6-DNT, HMX, RDX, Tetryl

Elevated levels of selenium have been detected in soil and groundwater; however, there is no evidence to suggest this metal has been released to the environment at UMCD. Additionally, perchlorate has been detected in groundwater at UMCD; however, it is also present regionally. These constituents are discussed further in this Five-Year Review Report; however they have been omitted from inclusion into Tables 2 and/or 3 because their sources are unknown. Perchlorate will be discussed further in Section V.

IV. Remedial Actions

The CERCLA remedial activities at UMCD were divided into eight OUs because of the variety of potential contaminants and the number of discrete sites (Army 1992a). These OUs and their respective ROD dates are listed below.

OPERABLE UNIT	ROD DATE
Explosive Washout Lagoons Soils OU	September 1992
Deactivation Furnace OU	December 1992
Active Landfill OU	August 1993
Inactive Landfill OU	August 1993
Explosives Washout Lagoons Groundwater OU	July 1994
Explosives Washout Plant OU	July 1994
ADA OU	July 1994
Miscellaneous Sites OU (Except Site 39)	July 1994
Site 39 (a sub-component of the Misc Sites OU)	May 2005

The following paragraphs discuss the remedial actions selected for the specific OUs addressed in this third Five-Year Review (also shown in Figure 2), and their implementation. The OUs for which additional reviews are required are: Explosives Washout Lagoons Groundwater OU, Ammunition Demolition Activity (ADA) OU, Site 39 of Miscellaneous Sites OU, and the Landfill OU (also previously referred to as the "Active Landfill" before RCRA closure). The OUs not addressed further in this review no longer have contamination above unrestricted standards.

Explosives Washout Lagoons Groundwater OU

The washout lagoons were two adjacent, unlined rectangular lagoons constructed in the native sandy-gravelly soil. The north and south lagoons measured 80 feet by 39 feet and 80 feet by 27 feet, respectively. Both were six feet deep. A 15-foot wide gravel berm separated the lagoons, and gravel berms encircled both lagoons. Depth to groundwater from the base of the lagoons varied from about 45 to 50 feet. The lagoons were typically dry; any collected precipitation tends to rapidly infiltrate. There was little to no vegetation in the lagoons and on the berms.

The Explosives Washout Lagoons (EWL) Groundwater OU addresses groundwater contamination caused by past waste disposal at the lagoons from a munitions processing plant. From the 1950s until 1965, UMCD operated an on-site explosives washout plant. The plant processed munitions by removing and recovering explosives using a pressurized hot water system. The wastewater was infiltrated into the on-site lagoons. The principal explosives consisted of TNT (2,4,6-trinitrotoluene), RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine), HMX (octahydro-1,3,4,7-tetranitro-1,3,5,7-tetrazocine), and tetryl (2,4,6-tetranitro-N-methyaniline). In addition, the

munitions contained small quantities of 2,4-DNT (2,4-dinitrotoluene), 2,6-DNT (2,6-dinitrotoluene), TNB (1,3,5-trinitrobenzene), DNB (1,3-dinitrobenzene), and NB (nitrobenzene), occurring as either impurities or degradation products of TNT.

Operation of the plant included flushing and draining the explosives washout system. The wash water from the plant was discharged via an open metal trough to the two infiltration lagoons located northwest of the plant. A total of 85 million gallons of effluent is estimated to have been discharged to the lagoons during the period of plant operation. The wastewater from the washout operation known as "pink water" contained high concentrations of explosives, primarily TNT and RDX.

The wastewater seeped from the lagoons and contaminated the soils and groundwater beneath them. The groundwater contamination was isolated to the unconfined (alluvial) aquifer. At the EWL, the saturated thickness of the entire unconfined aquifer ranges from approximately 15 to 35 feet.

Several soil and groundwater investigations were conducted at the EWL from 1981 to 1994. A network of 78 groundwater monitoring wells was used to identify and characterize groundwater contamination. Contaminants of concern identified in groundwater were TNT, TNB, DNB, NB, 2,4-DNT, 2,6-DNT, tetryl, RDX, and HMX. The most common contaminant was RDX, with concentrations originally ranging from below detection limits (<0.556 µg/L) along the contaminant plume perimeter to 6,816 µg/L. RDX also had the largest plume footprint at approximately 350 acres, all of it contained within the UMCD facility boundary.

The EWL Groundwater OU ROD requires cleanup to a level of beneficial reuse for groundwater which includes direct ingestion and dermal contact. Remedial Action Criteria were established in the ROD for the Explosive Washout Lagoons Groundwater OU based on Applicable, or Relevant and Appropriate Requirements (ARARs; e.g., Maximum Contaminant Levels (MCLs), Lifetime Health Advisories (HA)) or risk-based levels that provide a carcinogenic protection of 1×10^{-6} or a non-carcinogenic hazard quotient of 1. These criteria are:

TABLE 4. REMEDIAL ACTION CRITERIA, EXPLOSIVES WASHOUT LAGOONS GROUNDWATER OU

Contaminant of Concern	Remedial Action Criteria (µg/L)	Basis
TNB	1.8	Risk-based
DNB	4.0	Risk-based
TNT	2.8	Risk-based/HA
2,4-DNT	0.6	PQL
2,6-DNT	1.2	PQL
HMX	350	HA
RDX	2.1	PQL/HA

Note: HA – Health Advisory; PQL – Practical Quantitation Limit

The selected remedial action for the EWL Groundwater OU was extraction of the contaminated groundwater followed by granular activated carbon (GAC) treatment and reinfiltration of the treated water back into the aquifer. The major components of the remedy were:

- Extraction of the groundwater from an estimated three extraction wells over an estimated 10- to 30-year period.
- Treatment by GAC to meet performance standards based on the groundwater cleanup levels.
- In-situ flushing of subsurface soils beneath the lagoons with all or part of the treated groundwater for an estimated period of one year.
- Upgradient reinfiltration of the treated groundwater that does not go to the Explosives Washout Lagoons and all the treated water after the in-situ soil flushing is completed.
- Testing of the spent GAC to determine RCRA characteristic hazardous waste status.
- Off-site thermal treatment and disposal of explosives-contaminated GAC to the level specified in the Remedial Design
- Monitoring of groundwater contamination to determine effectiveness of the remedial action and to determine when the groundwater cleanup levels have been attained.
- Institutional controls on the contaminated groundwater to prevent its use until the cleanup levels are met.

Of the explosive compounds found in groundwater, RDX has the largest plume footprint. The remaining explosives-related contaminants are much less mobile than RDX and have smaller, more localized plumes. Beginning in 1995, the pump and treat system was constructed consisting of three extraction wells with a combined flow of 1,300 gallons per minute (gpm), a treatment plant with four 20,000-pound GAC filters, three infiltration fields, and ancillary piping. The pump and treat system began operating full-time in January 1997. Spent GAC is periodically sent off-site for thermal regeneration treatment. The objective of the remediation is to restore the unconfined aquifer to its full beneficial use by reducing the concentrations of contaminants of concern to less than the cleanup levels specified in the ROD within ten to 30 years. The soil flushing component of the remedy beneath the washout lagoons was completed in 2000. All treated groundwater is currently discharged to two active infiltration fields which reintroduce the treated water back into the aquifer.

From initial start up in 1996 through December 2008, approximately 6.5 billion gallons of contaminated groundwater were treated and returned to the subsurface through the infiltration fields, and 13,128 pounds of explosives were removed by the treatment system. As predicted, the rate of removal of explosives from treated groundwater has steadily decreased over time, as reduced explosives mass in the subsurface has led to reduced mass extraction efficiencies.

Remedial action groundwater monitoring for explosives has been conducted for the EWL Groundwater OU routinely since January 1997. In October 2005 monitoring frequency was reduced from quarterly (with a subset of wells sampled either semi-annually or annually) to semi-annually for all wells, and the number of sampled wells, including the three extraction wells, was reduced from 36 to 30. There are currently 29 wells in the chemical monitoring program and 50 in the groundwater level monitoring program. In February 2009 the groundwater extraction and treatment system began operating in the pulse-pumping mode, described further in Section V.

The extraction and treatment system design was finalized based on testing after the completion of the ROD. The anticipated scale of the system required to remediate groundwater to cleanup levels, as stated in the ROD, was a total pumping rate of approximately 140 gpm for 30 years, or 330 gpm for 10 years. The final design, however, indicated the system needed to be much larger, with a total pumping rate of about 1,300 gpm. Over the estimated remedial time of 10 to 30 years, the ROD estimated a total of 1.7 to 2.2 billion gallons of contaminated water would be extracted and treated. Due to higher actual extraction rates, 6.45 billion gallons of contaminated water has been extracted and treated to date. The estimates in the ROD were caveated by stating actual extraction rates and remedial timeframes may vary considerably due to lack of historical data, and the Five-Year Review would be instrumental in re-evaluating whether continuous pumping of the aquifer is the best method of attaining the groundwater cleanup levels.

ADA OU

The ADA OU is a 1,750-acre area located in the northwestern corner of UMCD. From 1945 to 1992, the ADA was used by the Army to dispose of ordnance by burning, detonation, dumping, or burial. Activities were conducted at a number of locations throughout the ADA. Soil contamination existed at 20 sites within the ADA. In addition, ADA activities resulted in the presence of quantities of munitions and explosives of concern (MEC) at locations across the ADA.

An extensive sampling and analysis program was initiated at the ADA as part of the Remedial Investigation (RI) conducted in 1992. The RI included an assessment of soil contamination at each of the 20 ADA sites as well as an overall assessment of potential groundwater contamination beneath the ADA. Future residential use of the ADA was viewed as unlikely due to the presence of MEC in unknown quantities at unknown depths and locations throughout the ADA. Based on the results of the RI, five locations - Sites 15, 17, 19, 31, and Site 32 - exceeded soil carcinogenic and non-carcinogenic risk-based levels based on an anticipated future industrial land use scenario, primarily for metals including arsenic and explosives residues. The remaining 15 sites had soil carcinogenic and non-carcinogenic risk levels below a level of concern. No significant contaminants of concern were identified in ADA groundwater at the time of the RI.

The selected remedy for the ADA OU in the June 1994 ROD had components for soil contamination and MEC clearance. The remedy to cleanup up soil contamination associated with the ADA was excavation, on-site solidification/stabilization treatment, and on-site disposal of the treated soils in the UMCD Landfill. Soil remediation criteria for the specific metals and explosives contaminants established in the ROD were:

TABLE 5. SOIL REMEDIATION CRITERIA, ADA OU

Contaminant of Concern	Cleanup Level (mg/kg)
Antimony	820
Arsenic	15
Barium	860
Beryllium	8.1
Cadmium	28
Chromium	40
Cobalt	25
Lead	500
Thallium	160
RDX	52
TNB	2.3
TNT	23
2,4-DNT	1.9

Cleanup steps designated in the ROD included excavation of approximately 14,000 cubic yards of soil at ADA Sites 15, 17, 19, 31, and 32, with MEC removed from these sites during excavation as necessary to permit safe excavation and access.

The ROD specified that the safety and environmental risks due to the presence of MEC were to be quantified and reduced in two phases, a Phase I surface clearance and a Phase II subsurface clearance. Phase I was to consist of a metallic object survey over the entire ADA to better estimate the quantity of metallic debris that would need to be removed to clear the ADA of MEC. Concurrently with the survey, a "visual sweep" would be conducted over the entire surface of the ADA to locate and remove objects identifiable as MEC. Phase II MEC clearance activities would then be dependent upon the future use selected for the ADA. As part of the BRAC process, future use for the ADA would be decided by the Army, the State of Oregon, and the local community. When a suitable future use was determined, additional Phase II MEC clearance activities would be conducted to a depth that was protective for the selected land use. Upon completion of the Phase II MEC clearance actions, appropriate institutional controls would be applied to the ADA to permanently limit the use of, and access to, the ADA. These institutional controls would be consistent with the final use selected for the area

and the degree to which MEC was successfully cleared. Possible controls could include deed restrictions, and/or maintenance of existing fencing and security. The ROD designated that Phase II MEC clearance activities would be initiated within 15 months after the final land use and disposal decision was made for the ADA.

In August 1995, the remedial design for soils at the ADA OU, as well as two other OUs - Miscellaneous Sites OU and Deactivation Furnace OU - was completed. The original remedial construction activities were conducted between June 1996 and August 1997. Treatment of contaminated soil was done from November 1995 to August 1997 utilizing a mobile onsite solidification/stabilization (S/S) system. The remedial action contractor was required to develop a mix design that would concurrently stabilize both metals and explosives to a Toxicity Characteristic Leaching Procedure (TCLP) level such that the treated soil would not be characterized as a RCRA hazardous waste and could be safely disposed in the UMCD Landfill. Sampling and analysis demonstrated that each batch of material sent to the Landfill met the leachate performance goals. The treated soil TCLP leachate criteria for the contaminants of concern in the ADA OU are shown below:

TABLE 6. TREATED SOIL CRITERIA FOR LANDFILL DISPOSAL, ADA OU

Contaminant of Concern	TCLP Leachate Level (mg/L)
Antimony	1.0
Arsenic	5
Barium	100
Beryllium	0.1
Cadmium	1
Chromium	100
Copper	140
Lead	5
Nickel	10
Silver	5
Zinc	1100
TNB	0.18
2,4-DNT	0.13
RDX	0.2
TNT	0.2
HMX	40

The soil remediation for the ADA was not completed under the remedial actions described in the preceding paragraph due to higher volumes of contaminated soil than

was expected and budgeted for during the remediation. On June 27, 2002, an explanation of significant differences (ESD) was published for Site 19E/F in the ADA. The ESD addressed the additional soils for remediation; the costs associated with the additional soils; updated cleanup levels based on revised exposure assumptions (elimination of troop training due to post closure under BRAC); and off-site treatment and disposal due to closure of the on-post Landfill.

Prior to additional soil remediation within ADA Site 19 E/F, a MEC clearance and survey was conducted soon after the ESD was finalized. Remediation then was conducted which included grid establishment and excavation, field screening, and confirmation sampling. Contaminated soil was stockpiled on site and characterized. This soil was subsequently transported off site where it was treated by stabilization/solidification and then disposed at an off-site treatment, storage and disposal facility. The final inspection for the completed remedial action occurred in October 2002, and the final Remedial Action Report for the ADA was issued in February 2005.

The ADA ROD, issued in 1994, stated that although all of the exceedences in risk-based values were due to the presence of arsenic in groundwater, no remediation of this constituent was required because: the levels were indicative of regional, background concentrations, the future residential use criteria were extremely conservative for the site, and all arsenic groundwater concentrations were below the MCL for arsenic at that time, which was 50 µg/l. However, the MCL for arsenic in groundwater was lowered to 10 µg/l in 2007, thereby making some ADA arsenic concentrations which were measured during the RI (at concentrations up to 40 µg/l) above the current MCL. The impact the MCL update has on the ADA is discussed further in Section VII.

Miscellaneous Sites OU

The Miscellaneous Sites OU consists of 32 sites that were identified as actual or possible locations of Army activities. The Miscellaneous Sites served a wide variety of specific functions, including sewage treatment and storm water discharge, munitions disassembly, Defense Reutilization Marketing Area (recycled materials stockpile), storage of raw materials, metal ingot storage, pesticide storage, paint spray and removal areas, paint sludge discharge areas, boiler/laundry wastewater discharge areas, disposal pits, and hazardous waste storage. The types of contaminants include organic compounds, metal salts, and pesticides (through application or disposal). Most of the Miscellaneous Sites are clustered in the southwestern or southern portions of the depot. The southwestern cluster of sites centers on warehousing, railroad unloading, and stockpiling activities. The southern sites include the administrative areas as well as support activities such as sewage treatment and storm water discharge. The remaining

Miscellaneous Sites are spread throughout UMCD and relate to a variety of support facilities for mission activities.

An extensive sampling program was conducted as part of the Remedial Investigation to assess soil contamination at each of the 32 sites as well as potential groundwater contamination beneath these sites. Groundwater was not found to be affected by past activities at the Miscellaneous Sites and required no cleanup under this OU. Based on the results of the RI, two sites, Site 22 (the Defense Reutilization Marketing Office DRMO) and Site 36 (Building 493 Paint Sludge Discharge Area), had soil contamination sufficiently elevated to require remediation. The contaminants of concern at Site 22 and Site 36 were lead, cadmium, and chromium. The other 30 remaining sites had acceptable levels of carcinogenic and non-carcinogenic risk for a future residential land use scenario and did not require remediation.

The remedy selected to clean up soil contamination associated with Sites 22 and 36 of the Miscellaneous Sites OU ROD was solidification/stabilization treatment and on-site disposal of the treated soil in the UMCD Landfill. These activities were carried out from November 1995 to September 1997. A total of 1,923 cubic yards of soils containing lead greater than 500 mg/kg and cadmium and chromium levels greater than the concentrations corresponding to a Hazard Quotient of 1 (127 mg/kg, and 40 mg/kg, respectively) were treated. The soil treatment resulted in meeting the TCLP criteria (1.0 mg/L, 5.0 mg/L, and 5.0 mg/L for cadmium, lead, and chromium, respectively) necessary for the treated soil to be placed in the UMCD Landfill.

After the first Five-Year Review, concerns were raised by UMCD about another of the 32 Miscellaneous Sites, Site 39 (the former Quality Assurance Function Range where ordnance was used). Site 39 is further discussed below.

Site 39 (A Component of the Miscellaneous Sites OU)

Site 39 is a 640-acre rectangular parcel of land located outside the northerly boundary of the UMCD. The site was acquired by the Army for use as a Quality Assurance (QA) Function Range for various types of conventional weapons, munitions, and related materials.

The ROD for Site 39, signed in May 2005, selected a response action consisting of MEC clearance to a depth of 2 feet in the Test Pad Area and Rifle Range areas of Site 39, and a MEC clearance to 6 feet in the Test Pit Area. These three areas requiring MEC clearance totaled approximately 176 acres. No Further Action was the selected remedy for the approximate 464 remaining acres of Site 39 because they were not considered to potentially contain MEC.

The major components of the Site 39 remedy were:

- Geophysical mapping of Test Pad, Rifle Range and Test Pit areas.
- Excavation and clearance of geophysical anomalies.
- Sifting of soil where obstructions prevented geophysical mapping.
- Collect and dispose off-site metallic debris that was non-live MEC.
- Disposal of live MEC either at the ADA or by detonation in place.
- Access restrictions during remedial action.
- Maintain signage and fencing after remedial action.
- At time of property transfer, deed notice will be required to inform land users the property was used for testing of munitions.

Remedial action work at Site 39 began October 2008, with survey and geophysical mapping followed by intrusive excavations. Investigation in the Test Pad Area included 747 discreet anomalies. No MEC was found at the Test Pad Area; however, numerous munitions debris and scrap metal was recovered during investigation of this area. Within the Rifle Range Area 876 discreet anomalies were investigated, three of which were MEC items. See Figure 9 for MEC locations within the Rifle Range Area of Site 39. The MEC were disposed of by demolition at the conclusion of project activities at the ADA. Nine discreet anomalies were investigated at the Test Pit Area using an armored excavator. In all, 1,632 discreet anomalies in the three areas of concern were investigated by excavation and yielded 324 pounds of munitions debris, 352 pounds of scrap metal and 3 MEC items.

Landfill OU

The Landfill OU is a 5-acre solid waste disposal area located in the northeastern portion of UMCD, near the eastern border, in a former gravel pit approximately one-half mile east of Coyote Coulee. The Landfill is located between areas known at UMCD as storage igloos blocks E and D (Figures 2 and 10). The disposal area consisted of a depression approximately 50 feet deep. Materials disposed at the site included garbage, demolition debris, asbestos from brake linings, dried sludge from the sewage treatment plant, possibly ash from the Deactivation Furnace, and explosives sludges.

The Army operated the Landfill from 1968 to 1997. ODEQ issued a landfill permit to the Army in 1979, and the permit was renewed in 1982. Municipal wastes from the UMCD facility, including debris generated by maintenance such as clearing and renovation activities, were disposed at the site and covered on a weekly schedule. The extent of activity at UMCD was significantly reduced after 1982, thereby reducing the volume of material placed in the Landfill. The peak work force at UMCD existed when the Landfill was first opened. During the Vietnam Conflict, approximately 1,000 people were employed at UMCD. However, by 1970, the work force began to decline and by 1987, the work force had fallen to 3 military and 250 civilian employees. The Landfill ceased receiving municipal waste on October 3, 1993, but continued to receive

treated soil from remediation of the Deactivation Furnace OU, Miscellaneous Sites OU, and the ADA OU. The Landfill was capped and closed in accordance with ODEQ Solid Waste Regulations in November 1997. The existing operating permit was reissued as a Solid Waste Disposal Closure Permit in August 2000. As a condition of closure, the Landfill will not be adversely disturbed in perpetuity.

An RI was conducted in 1992 with groundwater sampling activities performed at 10 adjacent monitoring wells. Analyses performed on the groundwater samples included: Target Analyte List (TAL) inorganics (which includes metals, non-metallic elements and cyanide), volatile organic compounds, semi-volatile organic compounds, pesticides, PCBs, explosives, and nitrate/nitrite.

The ROD selected "No Action" as the remedy for the Landfill OU. This selection was based on information generated during the RI, which indicated that the OU did not pose an unacceptable threat to human health and/or the environment. Under a future residential land use scenario, a viable option for reuse at that time, the potential carcinogenic risks and non-carcinogenic hazard quotient due to ingestion of groundwater at the Landfill OU were 5×10^{-5} and 2.0, respectively. Closure requirements for the Landfill were taken in accordance with the State of Oregon permit requirements. The State of Oregon Department of Environmental Quality provides oversight for inspections of the Landfill to ensure that post-closure requirements are maintained.

Groundwater monitoring of the closed Landfill was initiated in and has continued since October 1996. Monitoring has been conducted in accordance with the Environmental Monitoring Plan approved by ODEQ in 1997 (Army 1997a) and updated and approved in February 2007 (USACE 2007). Groundwater samples are currently collected on a semi-annual basis at 12 wells. Groundwater is analyzed for common anions and cations (calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulfate, chloride, nitrate/nitrite), trace metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver), VOCs (all compounds detectable by EPA Method 8260), explosives, and the following indicator constituents or other parameters: iron, manganese, silica, fluoride, zinc, copper, ammonia, total dissolved and suspended solids, total alkalinity, hardness, chemical oxygen demand, and total organic carbon. At seven of the 12 wells, only selenium and total dissolved solids are analyzed.

With the exception of selenium, the results from the sampling have been compared to the Table 1, 2, and 3 values from the Oregon Administrative Rules, Department of Environmental Quality 340 Groundwater Quality Protection (OAR 340-040). For selenium, the results have been compared to a risk-based level of 50 μg/L established by the ODEQ Cleanup Department in January 2003 (ODEQ 2003). Three groundwater monitoring wells have historically contained selenium above the 50 μg/L level (MW-34, 11-1 and 11-2, all cross-gradient wells. See Figures 10 and 12). Since the

2004 Five-Year Review, ODEQ has re-evaluated the selenium data and is developing a separate monitoring/cleanup plan under State Cleanup Program authorities which will emphasize institutional controls prohibiting use of groundwater with elevated selenium as the remaining remedy component in the region of the Landfill.

ODEQ's (Draft) UMCD Landfill Staff Report (ODEQ 2005) presents the recommended remedial action for groundwater at the UMCD Landfill under State Cleanup Program authorities. The recommended remedial action for the Landfill addresses the primary chemical of concern – selenium. The recommended remedial action consists of the following elements:

- Engineering controls (completed).
- Access controls (completed).
- Groundwater monitoring to document attenuation of Selenium (ongoing).
- Deed restrictions to prevent groundwater use as potable or livestock supply (recommended).

Although UMCD does not believe that elevated selenium near the Landfill is attributable to past Landfill operations, groundwater monitoring has continued. It should be noted that ODEQ does not concur that the Landfill is not the source of the elevated selenium. In ODEQ's Staff Report for the Landfill (ODEQ 2005), the source of elevated selenium was considered to be indeterminate. Nevertheless, the recommended remedial actions, as described above, allows for a remedial solution to proceed.

Post-closure requirements call for the groundwater monitoring well system be maintained for 10 years after the date of completion of closure. Because over 11 years has elapsed since any waste has been accepted at the Landfill, the updated Environmental Monitoring Plan states:

Groundwater sampling will continue on the schedule proposed in this Environmental Monitoring Plan through the complete closure of the landfill, and will continue for four years after closure. If, after that time, no evidence of a release has been detected, the Corps of Engineers [on behalf of UMCD] will petition ODEQ to eliminate the requirement for groundwater sampling at the landfill.

V. Progress Since the Last Review

Summary of October 2004 (Second) Five-Year Review

The second Five-Year Review concluded all remedies implemented at that time remained protective of human health and the environment. The remedies were operating

and functioning as designed and no modifications were deemed necessary, although for the Explosives Washout Lagoons Groundwater OU a recommendation was made to evaluate the optimization of system operations. This recommendation is currently being addressed.

Explosives Washout Lagoons Groundwater OU

Continuous Extraction and Treatment Operations

Evaluation of the RDX and TNT contaminant plumes continue and is based on continued semi-annual groundwater sampling historically conducted in spring and fall (usually in the months of April and October). The latest round of sampling for which data was reviewed for this report was from October 2008. Figures 3 and 4 depict RDX and TNT plume maps from the comprehensive round of groundwater sampling in October 2008. For comparison, RDX and TNT plume maps from November 2003, near the time of the second Five-Year Review, are shown in Figures 5 and 6. By comparing these two sets of maps it is evident that small declines in contaminant concentrations at most monitoring and extraction wells continue to be realized. However, both the amount of mass removed and the individual RDX and TNT concentrations at the treatment plant influent (SPINF), as shown on Figures 7 and 8, have asymptotically reached values that are quite small compared to historical levels. For example, average explosives removed by the extraction and treatment system for the last three quarters of its first year in operation (1997) was 25 pounds/day; however, one year later that rate was reduced to 16 pounds/day, and by 2004 it was reduced to just 0.4 pounds/day. In January 2009 the rate was 0.3 pounds/day.

The total estimated mass of explosives removed through December 2008 since system startup is 13,128 pounds; however, in the last full year of data (2008) only 91 pounds were removed. This represents only 0.7 percent of the total mass in eight percent of the total operational time. Because the treatment system mass removal rate has become asymptotically low, modifications to the system are being considered in accordance with the RODs provision for modifications should performance data indicate a need to so (EPA 1994).

Pulse-Pumping Operations

Modification options included in the approved remedy of the ROD are pulse-pumping (cycling the extraction wells off and on) and additional extraction wells to capture more mass and to treat the plume in a more cost-effective manner. The first modification to be actively evaluated was pulse-pumping. The rationale for the potential success of a pulse-pumping strategy is due to concentration rebound observed previously when the plant has been shut off for periods of about three weeks during carbon change-out, however the rebound effect was short-lived after pumping resumed.

Therefore it was postulated that longer shutdown periods should be explored to potentially increase the amount of mass that could be mobilized and later extracted, thus leading to potential faster total cleanup times.

As part of the pulse-pumping strategy, continuous extraction and treatment operations were halted in February 2009, and a contaminant rebound period was initiated followed by a week-long, short duration pulse-pumping event during mid-August 2009. Extraction wells and targeted monitoring wells were sampled during the initial pulse-pumping cycle to measure rebound in groundwater contamination levels or improvement in contaminant removal rates. The scope of the February to August 2009 pulse-pumping evaluation consisted of the following elements (SCS & EMR 2009):

- Baseline monitoring of all three extraction wells (EW-1, EW-3, and EW-4) and nine monitoring wells emphasizing zones near the extraction wells and high-concentration areas (wells 4-1, 4-102, 4-105, 4-111, 4-112, 4-25, 4-3, MW-2B, and W021) during routine continuous operations,

- Contaminant rebound aquifer monitoring at nine monitoring wells approximately 5 and 10 weeks after plant shutdown,

- Completion of a one week pulse-pumping event (August 14th to 21st) with groundwater extraction at all three wells at rates similar to those during continuous operations. During the pulse, monitor groundwater at each extraction well at 1, 4, 8, and 24 hour intervals and 5 days after plant startup. Also monitor groundwater at the nine monitoring wells approximately 24 hours and 5 days after plant startup,

- Collection of treatment plant influent, mid-GAC train, and effluent samples during the pulse-pumping event,

- Collection of area-wide water table elevation data during February, May, and August 2009, and

- Return the treatment plant to a non-operational status at the conclusion of the pulse-pumping event.

Contaminant mass removal estimates for the week-long pulse event ranged from 3.0 to 3.7 pounds of explosives (SCS & EMR 2009). The lower mass estimate was estimated from direct extraction well analytical and operational data, whereas the higher mass estimate was based on plant influent, mid-GAC, and effluent analytical and operational data. These mass estimates equate to mass removal rates of between 0.42-0.5 pounds of mass removed per operational day. For comparison, 2008 continuous plant operations removed 0.3 pounds per day. However, when comparing the entire six month period of pulse-pumping (both on and off cycles) to the last six months of continuous

operations in 2008, the contaminant mass removed from the aquifer during the pulse (3.0-3.7 pounds) was only about 7% of the total removed during continuous operations (45 pounds). Therefore, while increases in daily contaminant removal rates were possible utilizing the pulse-pumping mode of operation, it was evident that the treatment plant would not be operated sufficiently over the course of a year, even with reduced periods with the system cycled off, to match the contaminant mass recovered during the 2009 continuous operation period.

From a pure cost perspective, it may be concluded from the draft performance benefits evaluation (EMR 2009) that the reduced costs associated with pulse-pumping compared to that of continuous operations was not commensurate with the large-scale reduction in operation of the system.

Reviewers of the pulse-pumping evaluation noted that the pulse event in August 2009 did not occur at the historically highest seasonal groundwater elevation which typically occurs during the month of May. Based on evaluation of the August pulse-pumping event, it was postulated that perhaps significantly more contaminant mass held in unsaturated soils just above the water table may desorb into the aquifer during periods of higher groundwater elevation; thereby allowing for greater mass removal rates if pulse-pumping periods corresponded to the high groundwater period. Therefore, an additional pulse-pumping event with a similar monitoring scheme is being planned to correspond to the seasonally high water table in the May 2010 timeframe. A report will be prepared which will discuss the results of pulse-pumping accomplished in 2010 along with an assessment of plume containment during the pulse-pumping operation of the treatment system.

Additionally, and apart from the ROD-implemented remedial action, the Army is pursuing pilot-scale treatability and field-scale bioremediation studies in 2010 to evaluate whether the site is amenable to biological or enhanced-biological reduction of explosives both near the higher-concentration TNT and RDX source area and the distal RDX plume extents.

Remedial enhancement studies (USACE 2009b) and site exit strategy development (USACE 2006b) have also concluded that additional groundwater extraction wells placed in the remaining highest-concentration areas of the RDX and TNT plumes would help to capture more contaminant mass in a shorter timeframe than the current 24/7 P&T configuration; therefore additional extraction wells may be installed in the future pending the results of the pulse-pumping operating strategy, groundwater modeling results, pilot bioremediation studies, and discussions with regulators.

A numerical groundwater flow and transport model is being developed by USACE-ERDC for the Umatilla EWL Groundwater OU. The results of groundwater

modeling currently being conducted by ERDC will be used to determine the most advantageous operational strategy of the EWL extraction and treatment system. This includes evaluation of the most appropriate pulse-pumping strategy with respect to operational and shut down durations, as well as configuration of any future extraction wells, predictions of plume movement during system shutdown, and other scenarios as requested by the UMCD team. Proposals for further optimization, in-situ groundwater treatment, and/or monitored natural attenuation alternatives may result from these modeling activities once results have been obtained and evaluated.

ADA OU

The remedial actions required by the ADA ESD were performed from July to October 2002 and were discussed in the previous Five-Year Review which encompassed that time period; however the Final Remedial Action Report had not yet been completed at the time of the 2004 Five-Year Review. The Final RA report was issued in February 2005.

ODEQ Perchlorate Sampling

Between 2001 and 2005 the Oregon Department of Environmental Quality (ODEQ) sampled for perchlorate on and nearby the UMCD as part of a regional nitrate and perchlorate study. The results indicated low levels of perchlorate in groundwater on the UMCD at ADA and Landfill wells (average of about 5 µg/l with maximum of 10 µg/l, based on 23 samples), which were included in a report published by ODEQ (ODEQ 2006), with the exception of 2005 Landfill data which was collected subsequent to report preparation. The results also showed perchlorate to be present in areas off the UMCD and suggested elevated perchlorate levels may be a regional phenomenon. Although a 2008 EPA Interim Health Advisory of 15 µg/l currently exists, there is no established MCL for perchlorate, and perchlorate is not a contaminant of concern for UMCD sites based on current RODs.

Site 39

The vast majority of statutory and remedial construction progress made at Site 39 has been since the last Five-Year Review. See Section IV (Remedial Actions) of this report for progress details.

Landfill OU

Monitoring has been reduced from quarterly to semi-annually since the last Five-Year Review. Monitoring continues to show elevated selenium in wells side-gradient of the Landfill and elevated nitrate/nitrite throughout all of the permit-required monitoring

wells under consideration. Elevated nitrate concentrations are known to be a regional phenomenon in the area, and the ROD states that selenium was also found to be elevated regionally. The Environmental Monitoring Plan was revised in 2007 to comply with Landfill closure and to primarily address groundwater and cap maintenance. ODEQ has developed a remedial action clean up plan addressing the elevated selenium occurring near the Landfill under State authorities. A draft version of the plan was submitted and was reviewed by UMCD and USACE who provided comments. A recommendation was made in the last Five-Year Review to evaluate whether the remedy remains protective subsequent to the finalization of the ODEQ cleanup plan for selenium in groundwater. To date this task remains because the report has not been finalized, accepted, and implemented. The Army's position regarding selenium is that since it is present in side gradient wells which are not within groundwater flow paths of the Landfill, selenium is not from the Landfill. ODEQ disagrees with the Army position that the Landfill is not the source for elevated selenium; nevertheless, both parties agree on the need for a deed restriction prohibiting extraction/use of groundwater in vicinity of the Landfill when the Army vacates the site as long as selenium is above the standard. See Section VI, Data Review for further discussion.

ODEQ Perchlorate Sampling

ODEQ has conducted limited sampling for perchlorate, including at the Landfill OU. Five samples were collected at the Landfill in 2005 which were not included in 2006 ODEQ report. 2005 Landfill perchlorate results averaged 8 µg/l, with a maximum of 10 µg/l.

VI. Five-Year Review Process

Administrative Components

The U.S. Army is considered the designated Lead Agency of the UMCD Site and this Five-Year Review. The USEPA and ODEQ are the designated Support Agencies. Members of the UMCD BRAC Cleanup Team were notified of the intent to initiate the third Five-Year Review on December 16, 2008. The review team consists of personnel from EPA, ODEQ, US Army Environmental Command (AEC), US Army Materiel Command (AMC), US Army Chemical Materials Agency (CMA), USACE, USACE-ERDC, US Army Base Realignment and Closure Division (BRACD), and the Army's BRAC Environmental Coordinator at UMCD. The Seattle District, US Army Corps of Engineers is assisting the Army and UMCD with preparation of this Five-Year Review.

Community Notification and Involvement

This Five-Year Review Report will be made available to community members as well as the general public at the Hermiston Public Library (235 East Gladys Avenue, Hermiston, Oregon), Umatilla Chemical Depot Environmental Office (intersection of Cedar and D Streets), and at the EPA Region 10 Oregon Operations Office (805 S.W. Broadway, Suite 500, Portland, Oregon).

Document Review

Although historical documents were reviewed, the main focus of the review was on data reporting and evaluation of collected data since 2004, the date of the last Five-Year Review. Accordingly, the documents containing such data included the annual reports documenting groundwater monitoring and treatment system monitoring for the Explosives Washout Lagoons Groundwater OU (USACE 2005c, 2006, 2008a, 2009a), Site 39 Exit Brief (USACE 2008b), and the Landfill OU annual monitoring reports (USACE 2008c, 2008d). See Attachment 1 for a complete list of documents reviewed for this Five-Year Review.

Data Review

Focus on new data since the last Five-Year Review includes Explosives Washout Lagoons Groundwater OU groundwater monitoring and treatment system operational and compliance monitoring, as well as Landfill OU groundwater monitoring. Draft EWL pulse-pumping data and evaluation reporting were also reviewed (discussed in Section V). General remediation cost data were also reviewed for the EWL Groundwater OU and Landfill OU. Site 39 anomaly and MEC data were reviewed; however, because all items were removed from the site, no evaluation in terms of site impacts is required.

Explosives Washout Lagoons Groundwater OU

Groundwater Monitoring Data. Groundwater elevations and gradients have remained relatively stable over the past five years at this site. Flow direction, with the three groundwater extraction wells running, is consistently inward to these wells due to their large radial influence, as depicted in Figures 3 and 4. Without the operation of the extraction wells, the natural groundwater gradient magnitude at this OU is low. The gradient in this area is also influenced by seasonal agricultural pumping in the vicinity. The gradient direction actually reverses from its natural direction when agricultural groundwater extraction occurs, producing a somewhat stagnant plume overall due to these hydrologic conditions.

Historical rate of contaminant mass removal, as well as individual RDX and TNT concentration reduction data for the Explosives Washout Lagoons OU has been presented

in Section V. Since the last Five-Year Review, the levels of RDX and TNT in groundwater at most of the extraction and monitoring wells has either decreased, or in the case of some low-concentration monitoring wells, fluctuated around a mean. This data follows the pattern of decreasing trends since the treatment plant began operation in late 1996.

Although data have fluctuated somewhat, RDX concentration at a few wells have actually increased. An example of such a well is Well 8 located approximately 1,000 ft southwest of extraction well EW-3. This trend can clearly be seen on the first plot in Attachment 4. The earliest data available from Well 8, collected in October 1999, indicated RDX at a concentration of 1.7 µg/L. Recent (October 2008) RDX concentration at Well 8 was 10 µg/L. RDX at Well 8 appeared to have peaked in 2005 at a concentration of 22 µg/L. Increasing RDX also appears evident at wells 4-25, 4-111, 4-112, and 4-114 (Attachment 4) over the entire sampling history dating back to 1996, although RDX at well 4-25 has decreased since the last Five-Year Review in 2004. The reason for RDX increases at these specific wells is unknown, although operational changes to the extraction and infiltration components of the remedy likely played a role in the contaminant patterns over time.

Laboratory data quality was generally acceptable, with occasional exceedances of sample temperatures, holding times, and out of acceptable range surrogate spikes, matrix spikes, field duplicates, and detection limits. It appeared the appropriate data qualifier flags were given to qualified data by the laboratory and data were still usable for their intended purpose.

Overall, the footprint of the most highly contaminated zones within the RDX and TNT plumes have decreased in area within the zones of active groundwater extraction, which appears to verify the effectiveness of the groundwater extraction and treatment system. Footprint reduction is also likely aided by the effectiveness of the soil cleanup and flushing under the original lagoons which helped deplete source mass contributing to the groundwater plumes.

Not only have wells near the active extraction areas experienced declines in RDX concentrations, but those on the margins of the plume have as well. Examples of margin wells that have showed declines in RDX since 2004 are wells 4-25, 4-119, and 4-121. Data from these three wells, plus well 4-122, since the 2004 Five-Year Review were evaluated using the Mann-Kendall test for trend. Although overall RDX reduction in the eastern lobe has been slow, well 4-25 (the well with the highest eastern lobe RDX concentration ranging from 80 to 35 µg/l over the five-year period) and well 4-121 were found to have decreasing RDX trends at the 95% confidence level. The RDX trend at well 4-119 was decreasing at the 90% confidence level. Well 4-122 was shown to have no trend at the 90% confidence level but data was stable, with a negative Mann-Kendall statistic. No wells in the eastern lobe were found to have statistically significant

increasing trends or even positive Mann-Kendall statistics over the last five years. See Attachment 5 for details of the statistical evaluations.

The original monitoring program was believed to be more comprehensive than necessary to document conformance with water quality objectives. The Army, with regulatory concurrence, has made substantive efforts since 1997 to reduce the number of wells sampled and the number and frequency of parameters analyzed (Plexus 2000). Monitoring program refinement has continued to present and currently consists of semiannual analytical sampling of 26 monitoring wells and three extraction wells for explosives using Method 8330b.

Treatment System Operation and Compliance Data. In addition to groundwater monitoring data, groundwater extraction and treatment system operational and compliance data were also reviewed. The treatment plant, with a design capacity of 1,300 gallons per minute (gpm), ran at an average treatment rate of 1,225 gpm throughout 2005, and since that time has run at maximum capacity while in operation.

While in operation, the treatment plant operated within specifications and all effluent samples remained below the ROD remediation requirement levels of 2.8 µg/l for TNT and 2.1 µg/l for RDX. Carbon change-outs are important components of keeping the system operating within the ROD discharge criteria. As soon as explosives breakthrough is detected, the system is shut down to replace the carbon in each of the four vessels. Carbon change-outs since the last Five-Year Review have occurred in June and October 2005, April 2006, May 2007, and October 2008.

The system was last shut down for routine carbon change-out beginning in September 2008. The system was shut down between October 2006 and May 2007 for carbon change-out and non-routine maintenance and repairs. These repairs and maintenance included pump replacement in wells EW-1 and EW-3 and restoration of signal communication to these wells, installation of an uninterruptible power supply for the PLC/Alarm system, replacement of heater elements in the treatment plant building, replacement of the pre-lube solenoid valve at EW-4, rust removal and painting of pipe supports and piping, and replacement of three extraction well covers. The treatment plant was not in operation from August 2004 to March 2005 for an electrical upgrade, including replacement of water level sensor transducers in extraction wells EW-1 and EW-3.

Groundwater Monitoring and O&M Cost Data. The projected cost for 10-year and 30-year on-site groundwater extraction and treatment as stated in the ROD was $5.6 and $6.3 million net present value, respectively (USEPA 1994). Based on 12.5 years into either the 10-year remedy (which would be completed) or the 30-year remedy, this equates to approximately $9.7 and $11.1 million in constant dollar, undiscounted costs. Actual and projected total costs up to September 2009, after 12.5 years of operation, is

estimated at $4.72 million net present value, and $8.8 million in constant dollar, undiscounted costs. See Table 7 for summary by fiscal year. If the system were to operate continuously without the pulse-pumping strategy currently employed, the yearly O&M and monitoring costs would be about $440,000.

TABLE 7. ESTIMATED COSTS, EXPLOSIVES WASHOUT LAGOONS GROUNDWATER OU

Fiscal Year (Oct-Sep)	Expenditure (dollars)
1997	300,000
1998	99,200
1999	1,036,300
2000	100,000
2001	961,900
2002	426,000
2003	426,000
2004	--*
2005	449,800
2006	302,000
2007	119,100
2008	320,600
2009	442,000
Total”	4,727,300
*2004 data unavailable hence not included	

Landfill OU

Groundwater elevations have appeared to rise by as much as three feet over the last five years. The reason for this phenomenon is not known. Elevated groundwater has not appeared to have influenced the local groundwater gradient. Groundwater gradient remained consistent with years past, with principal flow direction being northeast to southwest (Figure 10). Regulatory exceedances have occurred at select wells for nitrate and selenium, as has been the case since the inception of the Landfill monitoring program. There is no apparent temporal trend in nitrate concentrations (Figure 11); however recent monitoring data suggests a slight downward trend in selenium concentrations (Figure 12).

Based on the most recent sample data, nitrate, selenium, and total dissolved solids have been detected in the Landfill wells at concentrations above regulatory levels (10 mg/L, 50 µg/L, and 500 mg/L, respectively). Historically, only nitrate and selenium have been above regulatory levels.

Selenium has been detected at wells MW-34, 11-1, and 11-2 at concentrations ranging from 50 to 100 µg/L over the past five years. All three of these wells are

considered hydraulically side-gradient of the Landfill, meaning the flow paths of these wells originate outside the Landfill by 100 ft in the case of MW-34, to by up to as much as 1,000 ft in the case of 11-2, which has the highest concentrations.

Cost data for the Landfill indicate yearly costs during the period covered by this Five-Year Review ranged from $70,100 to $79,000. Current costs are about $79,000 per year, the majority of which is associated with labor and analytical costs for semi-annual groundwater monitoring. There was no projected cost in the Landfill ROD, presumably because costs associated with five years of post-closure monitoring under Oregon Solid Waste Regulations (the only requirement with associated but unquantified cost included in the selected alternative within the ROD) was assumed to be minimal. Because the ROD implied there would be no costs after five years of closure, and since closure was over 11 years ago, all current and future costs associated with the Landfill OU act to reduce the cost-effectiveness of the remedy.

Site Inspection

The Site Inspection was conducted on August 19, 2009. Seattle District USACE personnel and the UMCD BRAC Environmental Coordinator participated in the Site Inspection. See Attachment 2 for the Site Inspection Checklist, and Attachment 3 for associated photographs of the toured sites.

Interviews

No formal interviews were conducted for this Five-Year Review. The USEPA and ODEQ regulatory agencies reviewed the draft version of this report and provided comments and input to the final report.

VII. Technical Assessment

Because the UMCD Site encompasses multiple OUs, each OU covered under this Five-Year Review is discussed separately.

Explosives Washout Lagoons Groundwater OU

1. Is the remedy functioning as intended by the decision documents? Yes.

The groundwater extraction and treatment system has operated successfully for 12.5 years. During that time the system has significantly reduced hot spot areal extent as well as overall contaminant mass in groundwater. The plume is being contained and the aquifer is being restored based on recent monitoring data and recent groundwater

modeling results. The treatment plant has similarly experienced steadily declining concentrations of contaminant influent, and has operated within compliance specifications during this time period. These observations are in accordance with the predicted behavior of a properly functioning pump and treat system, where the majority of contaminant mass is removed early and the effectiveness of the system, without optimization, diminishes over time. These findings are supported by the annual monitoring reports for this OU.

Opportunities for optimization or enhancement of the treatment system do exist. The system is currently being operated under a pulse-pumping mode in an attempt to increase operational efficiency. An enhancement study has also determined the addition of up to two new extraction wells located within the remaining high-concentration zones of the RDX and TNT plumes would increase mass removal rates in the near-term. Optimization scenarios are currently being modeled by USACE-ERDC to determine the best path forward for operation of the system.

Institutional controls (ICs) are non-engineered instruments that minimize potential for human exposure to contaminants, limit incompatible land use, and/or protect the integrity of the remedy. The UMCD Policy Statement Number 03-75 enforces restrictions on all subsurface excavation to protect the health of workers and infrastructure. The policy requires the completion of an excavation permit application for review and approval by the installation Public Works, Environmental, and Safety Departments. In addition, other measures limiting access are in place such as restricted Depot access and 24-hour armed patrols.

A previous groundwater modeling effort (SCS 2009) suggested the current P&T system was not capturing the RDX plume within a five year zone of capture. Recent ERDC groundwater modeling appears to contradict the previous findings, but because recent modeling results have yet to be documented into a formal report, plume containment is listed as an issue in Table 8, with a follow-up recommendation in Table 9. Based on all the information presented above, the Explosives Washout Lagoons Groundwater OU remedy is functioning as intended by the ROD.

2. Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy still valid? Yes.

The exposure assessment described in the ROD included provisions for three exposure pathways based on a future residential exposure scenario: ingestion of contaminated groundwater, dermal absorption of contaminated groundwater during showering, and consumption of crops irrigated with contaminated groundwater. These exposure pathways may or may not be ultimately realized; however, the remedial action objectives stated in the ROD include the restoration of contaminated groundwater to a beneficial level that is protective of human health in accordance with the provisions of

CERCLA, the NCP, and EPA policies at NPL sites, and the cleanup levels have not changed.

The original, conservative assumptions utilized for the risk assessment calculations are being handled by institutional controls which would be kept in place as long as necessary. Toxicity data have remained unchanged except for the following: oral reference dose has increased for two compounds 1,3,5-trinitrobenzene (from 5.0E-5 to 3.0E-2 mg/kg-day) and 2,4-dinitrotoluene (from 6.0E-4 to 2.0E-3 mg/kg-day) (IRIS 2009). The increase in reference dose of these chemicals does not impact the protectiveness of the remedy.

3. Has any other information come to light that could call into question the protectiveness of the remedy? No.

No other information has become available that could call into the question the protectiveness of the remedy.

ADA OU

1. Is the remedy functioning as intended by the decision documents? Yes.

Since an industrial land use was used to establish the cleanup levels for the soil remediation at the ADA, this remedial action resulted in hazardous substances remaining on-site in soil above levels that do not allow for unlimited and unrestricted use. In addition, the ordnance removal remedial actions have resulted in the possibility of subsurface munitions and explosives of concern remaining on-site that will not allow for unlimited and unrestricted use. Therefore, CERCLA Five-Year Review requirements will apply to the soil and ordnance remedial actions and this OU will require long-term management or review. In order to ensure that this cleanup remedy continues to be protective, an ADA OU review will be conducted every five years. Because Phase II MEC clearance work has not been undertaken owing to uncertain land reuse, this review will include review of the progress of the completion of the Phase II MEC clearance, verifying that ICs remain in place, and the land use of the ADA has not changed. In addition, any land transfer will be subject to CERCLA Section 120(h) provisions.

The UMCD Policy Statement Number 03-75 is an IC which enforces restrictions on all subsurface excavation within the ADA. Although not strictly ICs, engineered controls preventing access such as fencing and warning signage are in place as well. Furthermore, once unexploded ordnance removal in accordance with land reuse requirements occurs, the ROD requires ICs be applied to the ADA to permanently control access to, and use of, the ADA consistent with the final use selected.

The Remedial Action Report documented the successful completion of the selected remedy of excavation and treatment of contaminated soils at the ADA, including that of Site 19 E/F for which the ESD applied. Therefore the remedy is functioning as intended by the ADA ROD and ESD.

2. Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy still valid? No.

The exposure assumptions, including likely routes of exposure, land re-use assumptions, and soil contaminant concentrations assuming the ADA remained in its pre-remediation state, remain conservative but valid as presented in the ROD, and as revised in the ESD for Site 19 E/F. Toxicity data and remedial objectives also remained valid as contained in the ROD and/or ESD.

However, in 2007 the MCL for arsenic was lowered from 50 to 10 µg/l. Although no groundwater arsenic concentrations have been measured above 50 µg/l, there were monitoring wells that experienced arsenic above 10 µg/l based on RI data, and as also reported in the ADA ROD. Therefore, unless concentrations have decreased markedly over time, groundwater arsenic concentrations are likely no longer considered protective at the 10^{-4} risk level. ADA wells which historically showed arsenic concentrations above 10 µg/l are recommended for updated sampling, analysis, and evaluation against the new MCL standard, as listed in Tables 8 and 9. The Oregon Water Resources Department has indicated, as part of the Land Reuse Authority planning, that no additional withdrawals will be allowed from the Ordnance Gravel aquifer CGA and therefore, should new arsenic data show continued exceedances of 10 µg/l, the exposure pathway will continue to be incomplete.

3. Has any other information come to light that could call into question the protectiveness of the remedy? No.

No other new information was discovered that would call into question the protectiveness of the remedy for the ADA.

Site 39

1. Is the remedy functioning as intended by the decision documents? Yes.

The physical component of the remedy completed in 2008 included removal of potential MEC on a total of 176 acres within the Test Pad Area, Rifle Range Area, and the Test Pit Area. The remedy also included a finding of "No Further Action" for a total of 464 acres which were not considered to potentially contain MEC. Soil and groundwater were not found to be affected by MEC activities at Site 39 and did not require cleanup under the ROD. This site has not yet achieved formal closure; however,

there are no longer any hazardous substances remaining on site above levels that allow for unlimited use and unrestricted exposure.

As part of engineered control restrictions to the site, UMCD will maintain Depot access restrictions as well as fencing and signage deterrents to site access. At the time of future property transfer, deed notification will be required to inform the new property owner that the property was once used for testing of munitions. This notification will meet the requirements for State real property deed notifications and will become the lone IC. This information will be included in the transfer documents and will be recorded at the time of transfer.

With this information in mind, the remedy is functioning as intended.

2. Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy still valid? Yes.

The assumptions related to MEC hazards, and the remedial objectives used at the time of the remedy remain valid.

3. Has any other information come to light that could call into question the protectiveness of the remedy? No.

No new information has come to light that could call into question the protectiveness of the Site 39 remedy.

Landfill OU

1. Is the remedy functioning as intended by the decision documents? Yes.

The remedy appears to be functioning as designed for the Landfill OU. The only contaminants detected above regulatory levels near the Landfill are nitrate, which is similar in magnitude to regional background levels, and selenium. ODEQ Solid Waste and Cleanup Regulations will continue to apply, along with associated monitoring and inspection requirements. ODEQ is developing a cleanup plan for selenium in groundwater pursuant to State authorities but outside the CERCLA "no action" remedy. Once that plan is finalized and implemented, any implications for the CERCLA remedy should be evaluated to ensure that the remedy remains protective.

2. Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy still valid? Yes.

The ROD was finalized in 1993 which declared a remedy of "No Further Action." Based on results of the human health risk assessment, the Landfill OU in its then-current state and a future residential land use scenario was determined not to pose an

unacceptable risk to public health or the environment. Since routine groundwater monitoring began in 1995, elevated levels of nitrate and selenium have been consistently detected in wells surrounding the Landfill. This monitoring data does not represent a change in exposure assumptions because nitrate and selenium concentrations have either remained stable or declined since the ROD. Also, under the ODEQ clean up plan (ODEQ 2005), deed restrictions would be put into place ensuring protectiveness of any applicable reuse.

3. Has any other information come to light that could call into question the protectiveness of the remedy? No.

No new information has come to light that could call into question the protectiveness of the Landfill OU remedy.

VIII. Issues

This section details issues related to current site operations, conditions, or activities and evaluates whether the issues affect current or future protectiveness of the associated remedy. The following table summarizes the issues identified during this third Five-Year Review.

TABLE 8. ISSUES IDENTIFIED DURING THE THIRD FIVE-YEAR REVIEW

Issue	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
1. (Explosives Washout Lagoons Groundwater OU). Treatment system in continuous operation mode has become less effective at removing contaminant mass and reducing contaminant concentrations. System is currently operating under a pulse-pump mode to evaluate if this technique can either be more effective at removing mass and/or if it can shorten the cleanup time frame. A groundwater model is currently under development by USACE-ERDC and will be used to assist the UMCD team with decision making scenarios for the EWL groundwater, including appropriate pulse-pumping periods, additional extraction well installation, bioremediation scenarios, and impacts of discontinuing the pump and treat system.	N	Y
2. (EWL GW OU). Conflicting RDX plume containment information. Plume containment appears to be more certain based on recent data and ERDC groundwater modeling when compared to previously published results of five-year capture zone modeling (SCS 2009).	N	Y
3. (Landfill OU). Landfill OU groundwater monitoring has continued well beyond four-year post-closure requirement with no evidence of release. Consider eliminating or reducing monitoring requirements. Nitrate and selenium are elevated; however, as	N	N

Issue	Affects Current Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
long as controls are maintained to prevent groundwater use, the exposure pathway is incomplete. ODEQ Staff Report/ROD cleanup plan has not been accepted by the Army or finalized.		
4. (ADA OU). Disposal trenches that are believed to contain MEC have not been fully characterized or remediated. Phase II MEC clearance has not occurred. Current access restrictions are adequate to maintain protectiveness until final remedial actions are selected and implemented; however these restrictions will require inspection and maintenance until final remedial actions are in place.	N	Y
5. (ADA OU). Although regionally elevated groundwater arsenic concentrations were below the MCL at the time the ROD was issued, the reduction of the MCL from 50 to10 µg/l in 2007 now means levels are likely above the MCL.	N	Y

IX. Recommendations and Follow-up Actions

Recommendations and follow-up actions have been identified and are presented in the table below.

TABLE 9. RECOMMENDATIONS AND FOLLOW-UP ACTIONS

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Proposed Completion Date
1. Explosives Washout Lagoons Groundwater OU - Treatment system diminished effectiveness	Evaluate pulse-pump mode of operation and evaluate groundwater model results with respect to pulse-pumping; if ineffective consider alternate means of optimization/ enhancement, including pilot bioremediation testing.	Army	EPA and ODEQ	December 2010 (currently underway)
2. EWL RDX plume containment	Reevaluate by running and formally documenting five-year capture zone analysis using latest groundwater model to demonstrate RDX plume containment, particularly in eastern lobe. As part of this effort, regression analysis will be used to predict the time frame for RDX levels in eastern lobe groundwater to drop below the regulatory level.	Army	EPA and ODEQ	April 2010
3. Landfill OU – Eliminate or reduce groundwater monitoring	Finalize ODEQ Staff Report/ROD cleanup plan, determine whether remedy remains protective and if so, eliminate or reduce groundwater monitoring requirement.	ODEQ/Army	EPA	2010
4. ADA OU – Phase II MEC	Once an agreement has been reached on land reuse, Phase II	Army	EPA and ODEQ	2012

clearance	subsurface MEC clearance activities will be performed within 15 months as per ROD.			
5. ADA OU – lowering of arsenic MCL	Recommend sampling select wells that have historically had arsenic above 10 µg/l, and to assess impacts on future land use and ICs once funding becomes available to do so, and before next Five-Year Review.	Army	EPA	2012

X. Protectiveness Statements

Protectiveness statements have been developed for each OU addressed in this Five-Year Review. A comprehensive, site-wide protectiveness statement covering all the remedies at UMCD within this FYR has not been developed in accordance with FYR guidance because construction completion has not been achieved for the ADA due to the deference of the Phase II MEC removal. Protectiveness statements for all pertinent OUs are discussed below.

Explosives Washout Lagoons Groundwater OU

The remedy is operating and is expected to be protective upon completion; in the interim, prohibition on the use of groundwater will be required to ensure short-term protectiveness. All exposure pathways that could result in unacceptable risks are currently being controlled.

ADA OU

The remedy at the ADA OU is protective of human health and the environment in the short-term because controls are in place to prevent exposure to the remaining MEC and exposure to arsenic in groundwater by prohibiting usage; however, to be protective in the long term, additional actions are required. The future land use decision will dictate specifically what follow-on MEC clearance remedial action will be required, and updated groundwater sampling results will determine what land use controls must remain in place for the site to remain protective in the future.

Site 39

The remedy at Site 39 is protective of human health and the environment because all media preventing unlimited use and unrestricted exposure have been removed.

Landfill OU

The remedy at the Landfill OU currently protects human health and the environment because all known landfill-related contaminants of concern which pose risk with the possible exception of selenium are below regulatory levels and because, although selenium in groundwater is elevated, there is currently no complete exposure pathway for groundwater. However, for the remedy to be protective in the long-term, deed restrictions may be required preventing use of groundwater resources within and downgradient of the elevated selenium area once the property is transferred from Army ownership.

XI. Next Review

The next five year review will be completed by September 2014. Future Five-Year Reviews are necessary because contamination in place resulting from the selected remedies remains above levels that allow for unrestricted use and unlimited exposure at the Explosives Washout Lagoons Groundwater OU and the ADA OU.

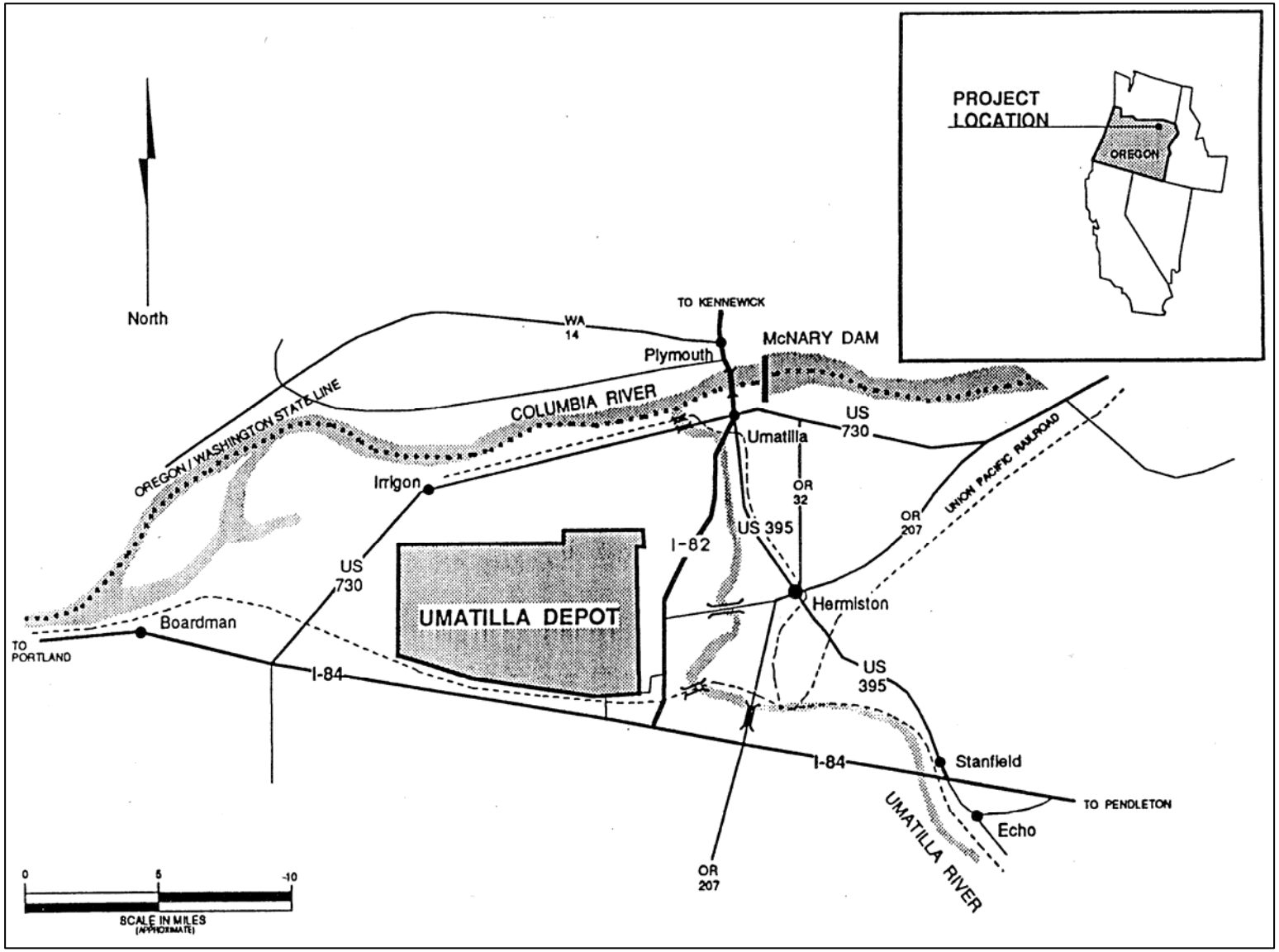


Figure 1. Facility Location Map

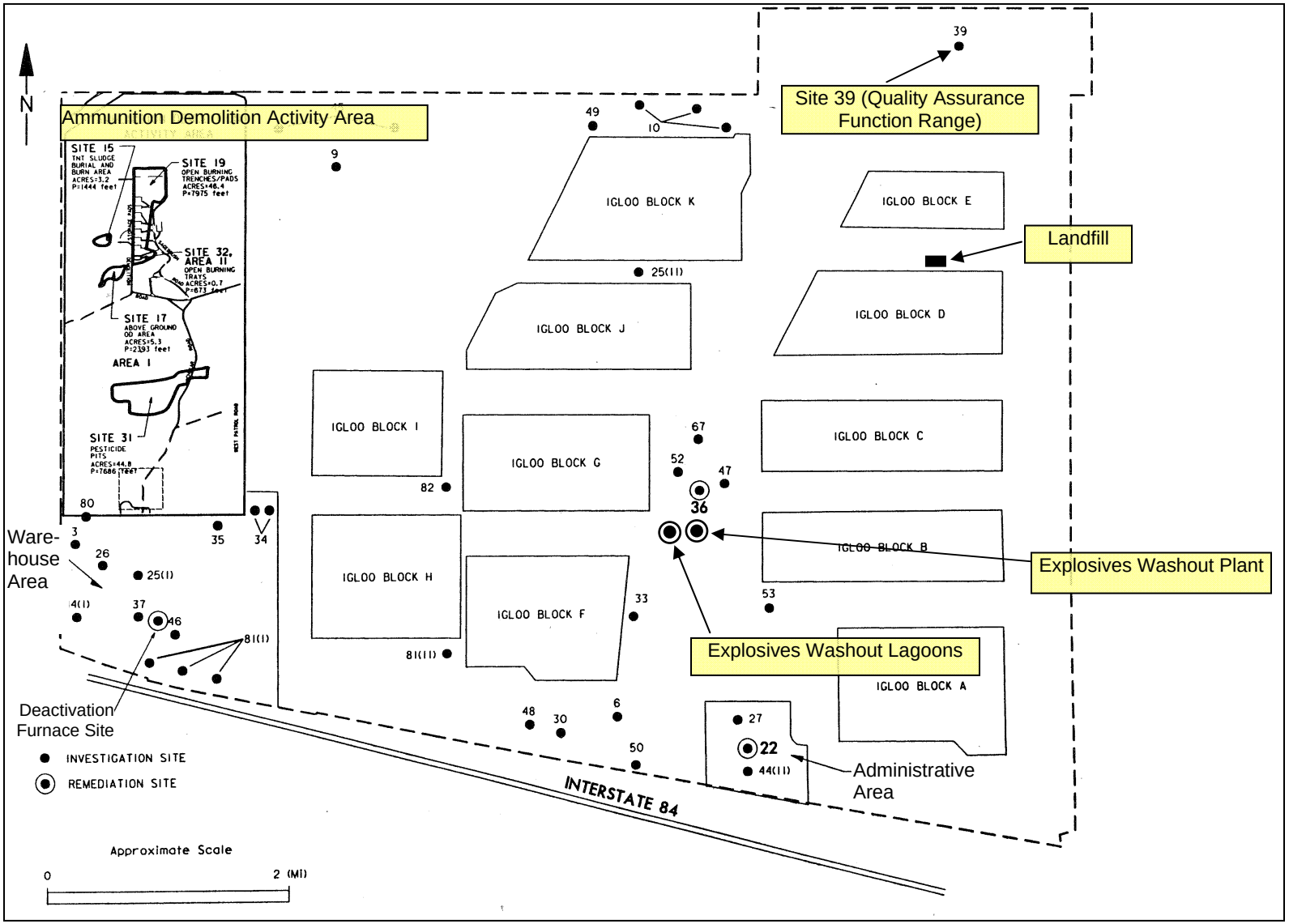
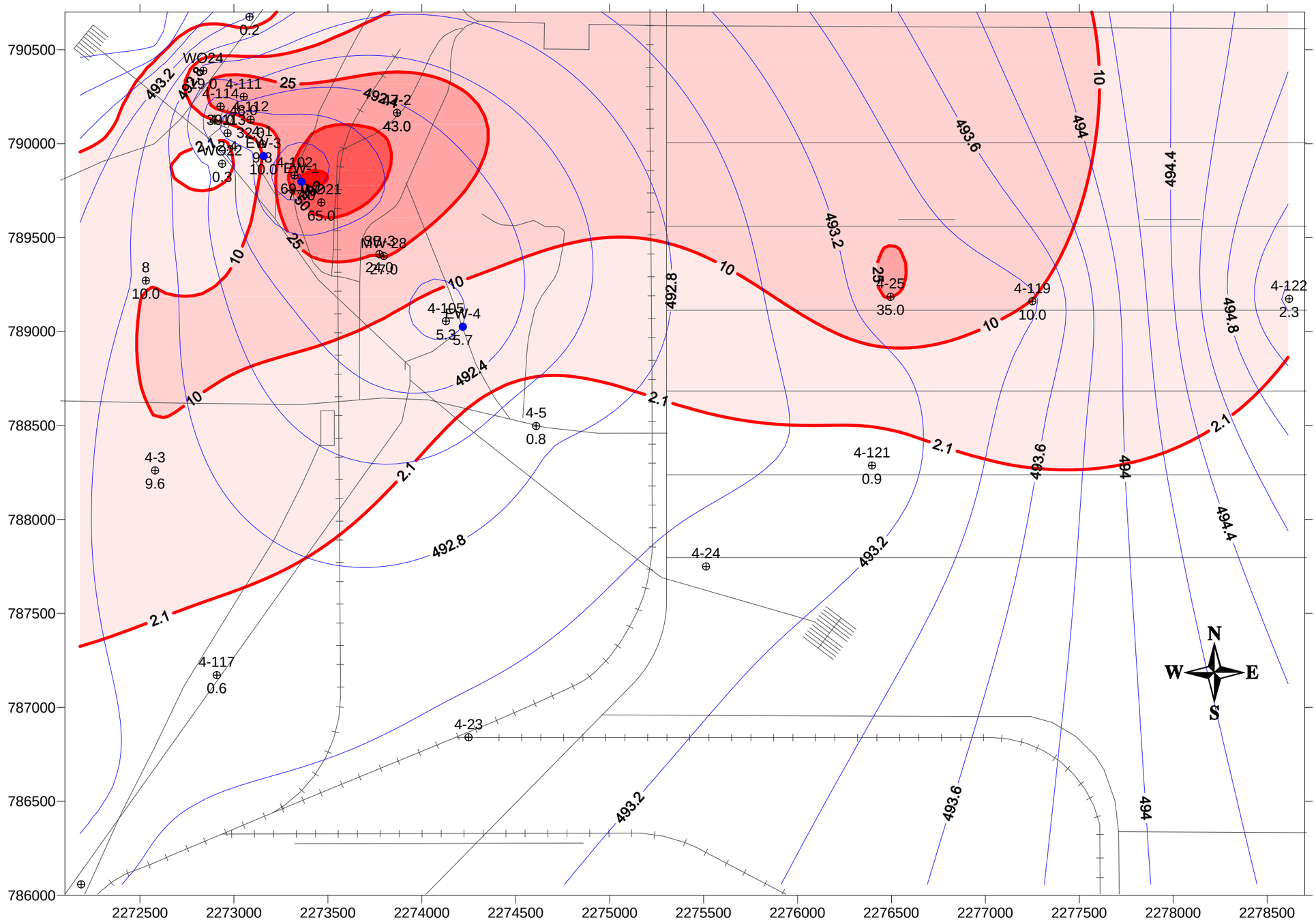


Figure 2. Site Map



LEGEND

- ⊕ Well Location (Well ID above, concentration below)
- ● Extraction Well (EW) Location
- Contaminant concentration isocontour
- Groundwater elevation contour

NOTES:

1. Contours were generated by SURFER using linear kriging with linear drift.
2. Contours are based on alluvial aquifer well data only for the sampling round indicated, with the following exception: Apr 2008 data used for well SB-3 on Oct 2008 map because well not sampled at that time.

SCALE BAR (FEET)

0 250 500 750 1000

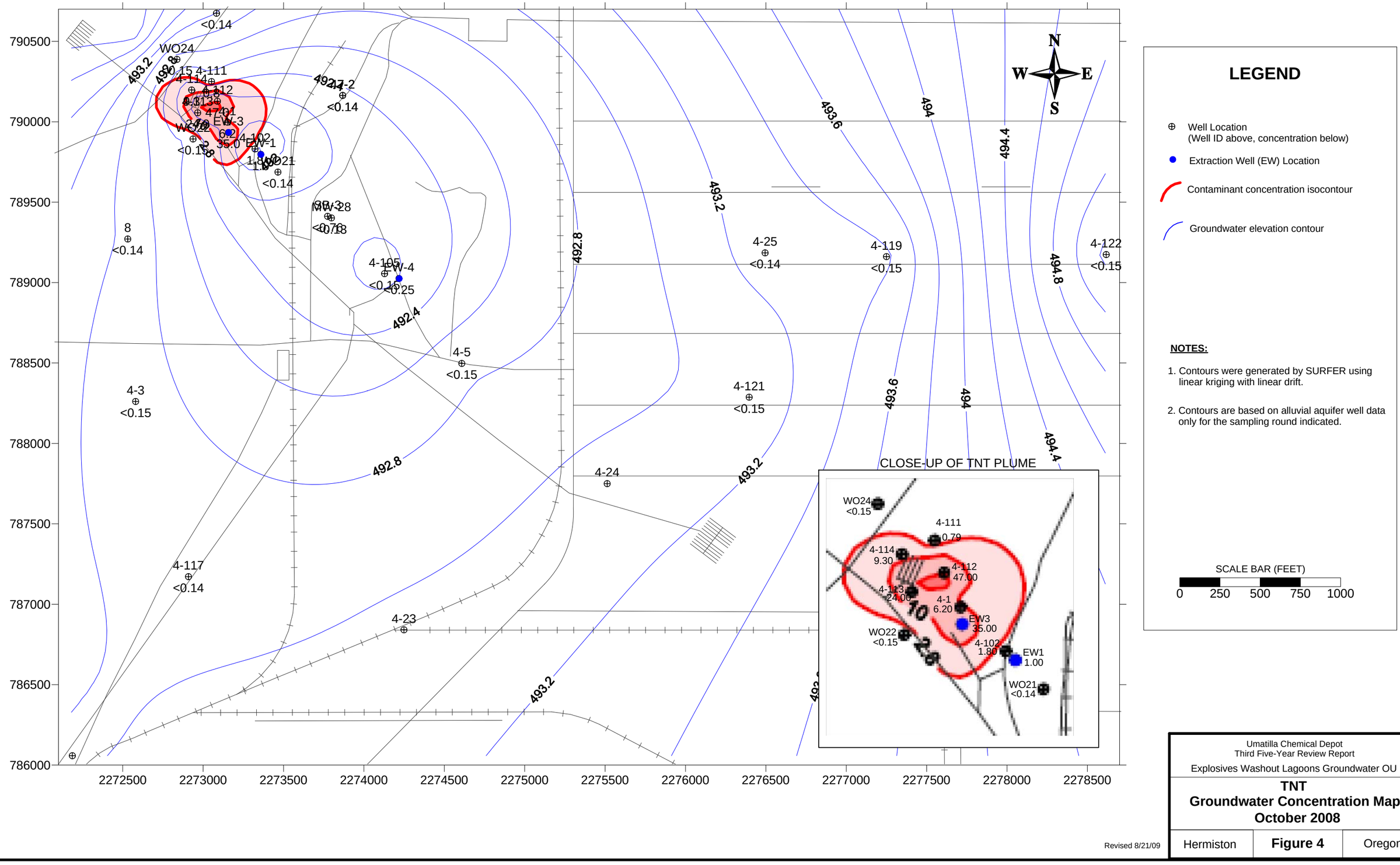
N W E S

Revised 2/9/10

Umatilla Chemical Depot
Third Five-Year Review Report
Explosives Washout Lagoons Groundwater OU

RDX
Groundwater Concentration Map
October 2008

Hermiston	**Figure 3**	Oregon

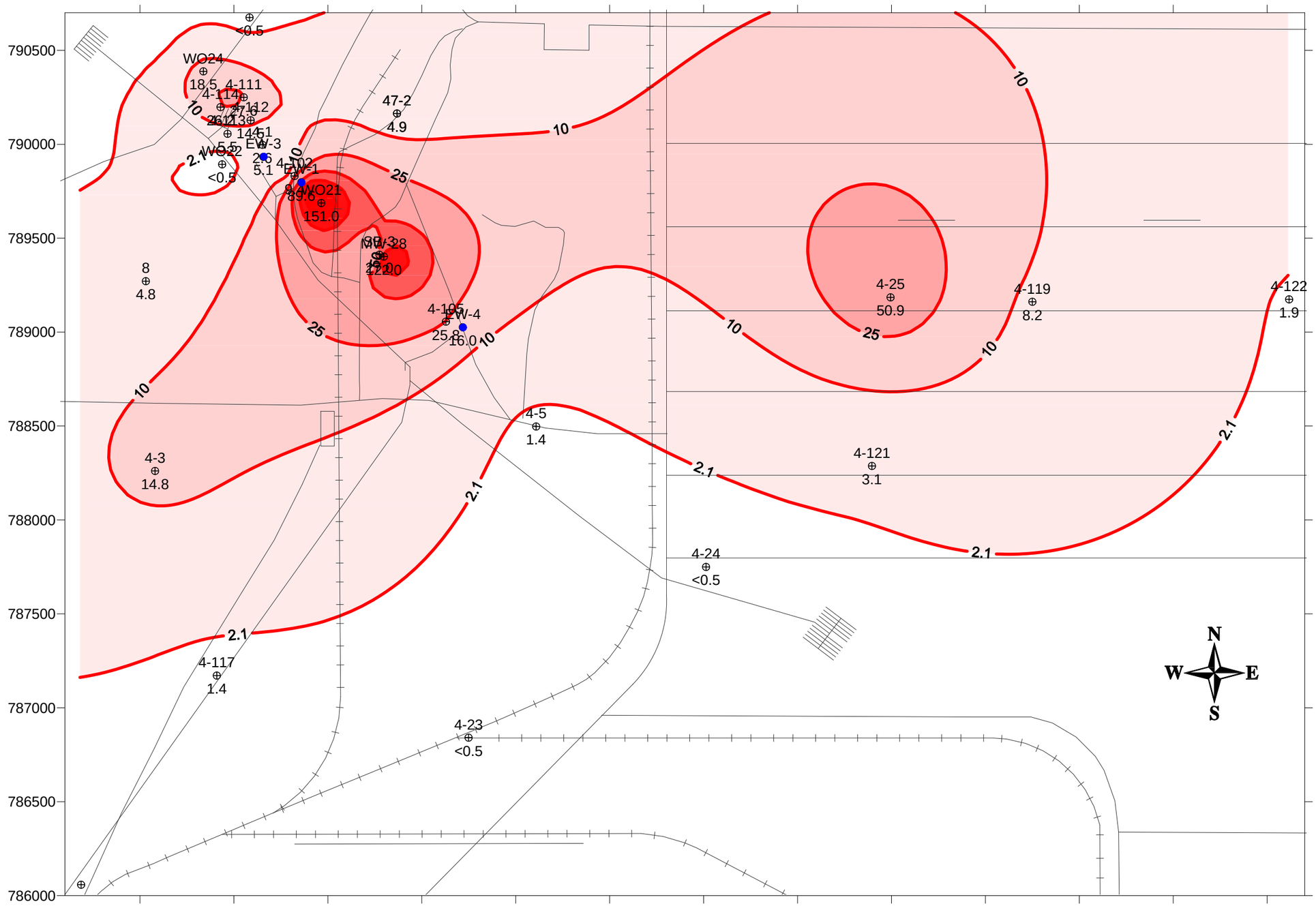


Umatilla Chemical Depot
Third Five-Year Review Report
Explosives Washout Lagoons Groundwater OU

TNT
Groundwater Concentration Map
October 2008

Revised 8/21/09

Hermiston	**Figure 4**	Oregon



LEGEND

- ⊕ Well Location (Well ID above, concentration below)
- ● Extraction Well (EW) Location
- Contaminant concentration isocontour

NOTES:

1. Contours were generated by SURFER using linear kriging with linear drift.
2. Contours are based on alluvial aquifer well data only for the sampling round indicated, with the following exception: Apr 2003 data used for wells 4-5 and SB-3 on Nov 2003 map because they were not sampled at that time.

SCALE BAR (FEET)

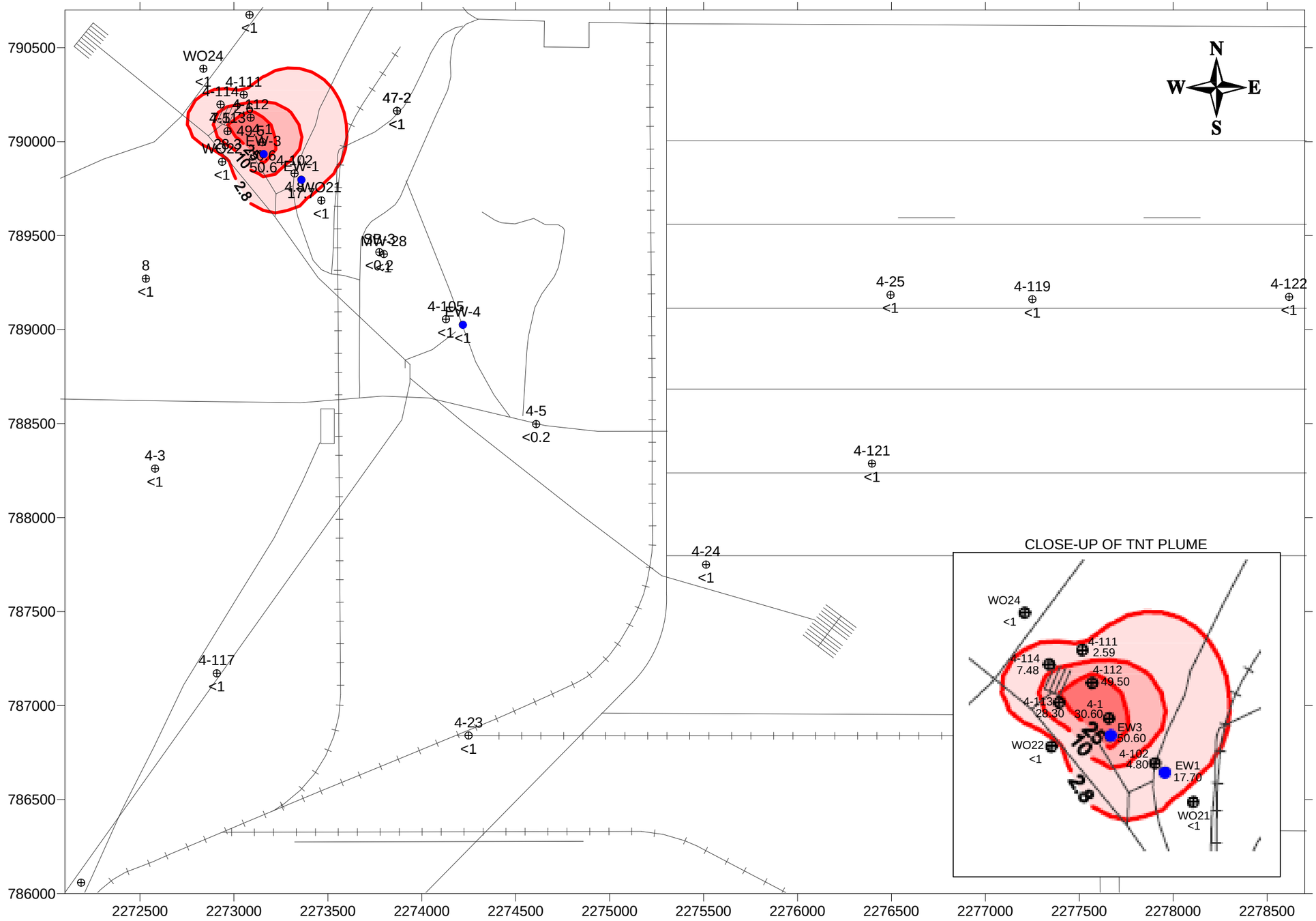
0 250 500 750 1000

Revised 8/21/09

Umatilla Chemical Depot
Third Five-Year Review Report
Explosives Washout Lagoons Groundwater OU

RDX Groundwater Concentration Map November 2003

Hermiston	**Figure 5**	Oregon



CLOSE-UP OF TNT PLUME

LEGEND

- ⊕ Well Location (Well ID above, concentration below)
- ● Extraction Well (EW) Location
- Contaminant concentration isocontour

NOTES:

1. Contours were generated by SURFER using linear kriging with linear drift.
2. Contours are based on alluvial aquifer well data only for the sampling round indicated, with the following exception: Apr 2003 data used for wells 4-5 and SB-3 on Nov 2003 map because they were not sampled at that time.

SCALE BAR (FEET)

0 250 500 750 1000

Umatilla Chemical Depot
Third Five-Year Review Report
Explosives Washout Lagoons Groundwater OU

TNT
Groundwater Concentration Map
November 2003

Revised 8/21/09

Hermiston	**Figure 6**	Oregon

Figure 7. Historical Contaminant Mass Extraction Rate, Washout Lagoons Groundwater OU

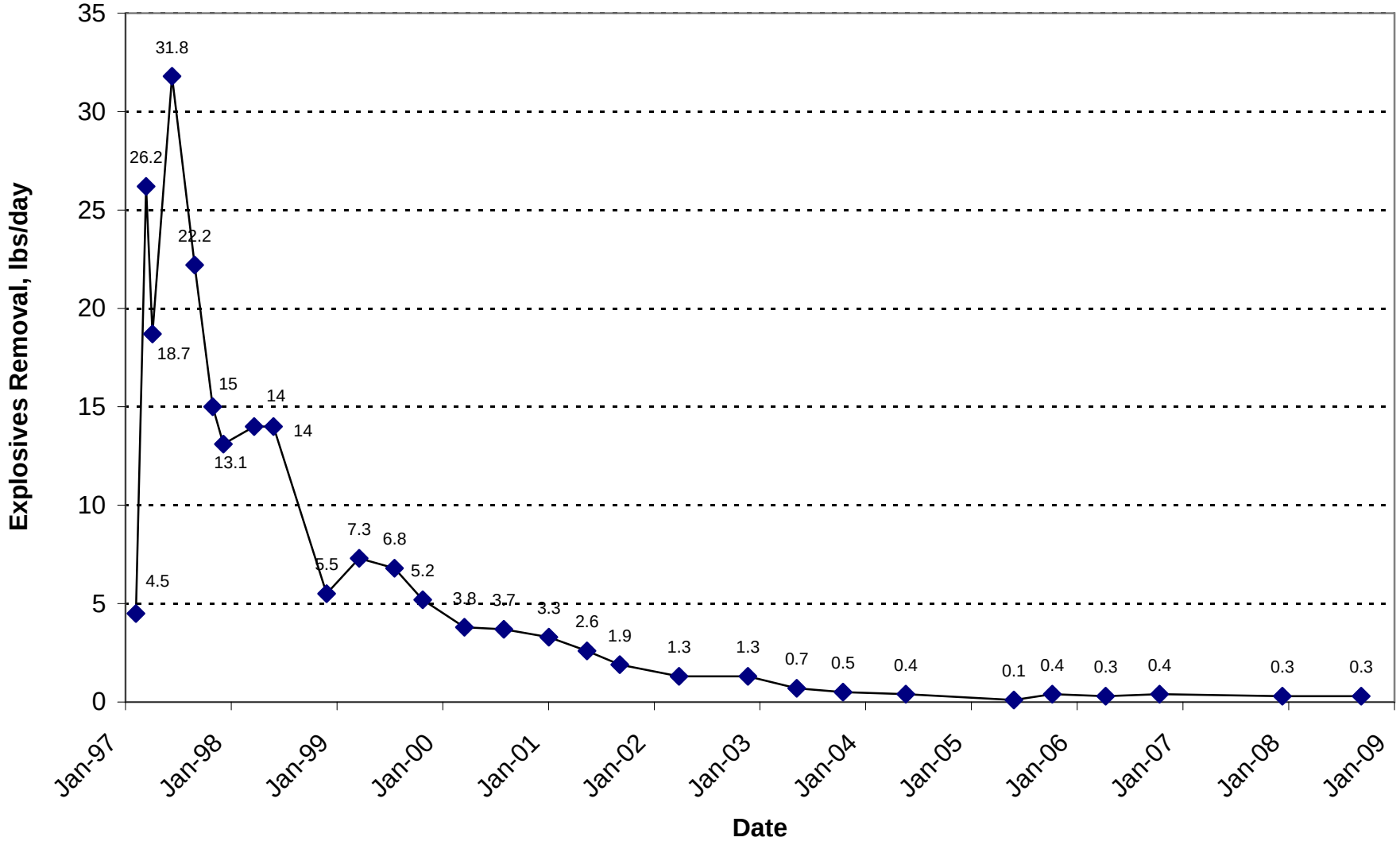
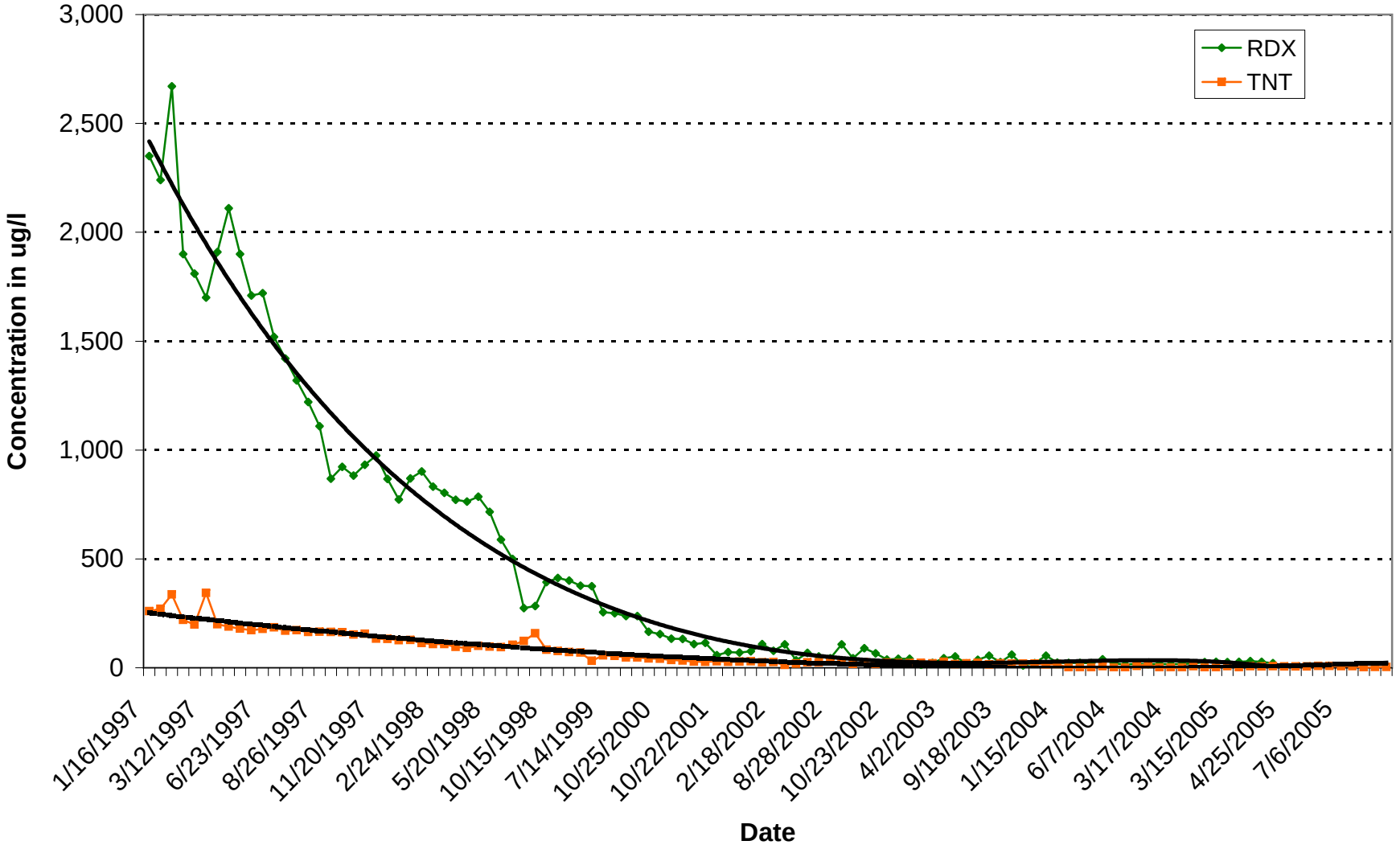


Figure 8. Explosives Concentrations at SPINF, Washout Lagoons Groundwater OU



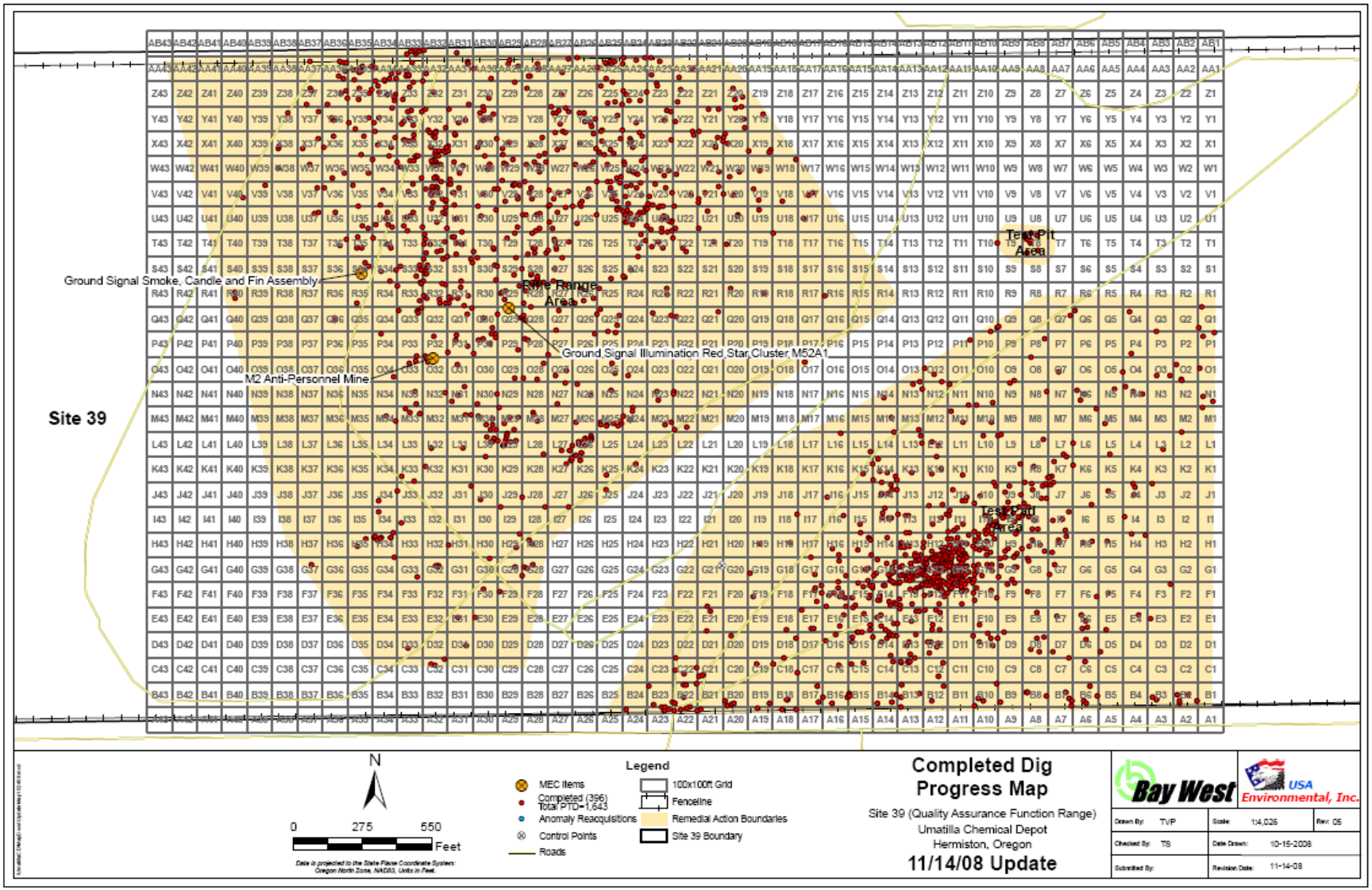


Figure 9. MEC Removal Locations, Site 39

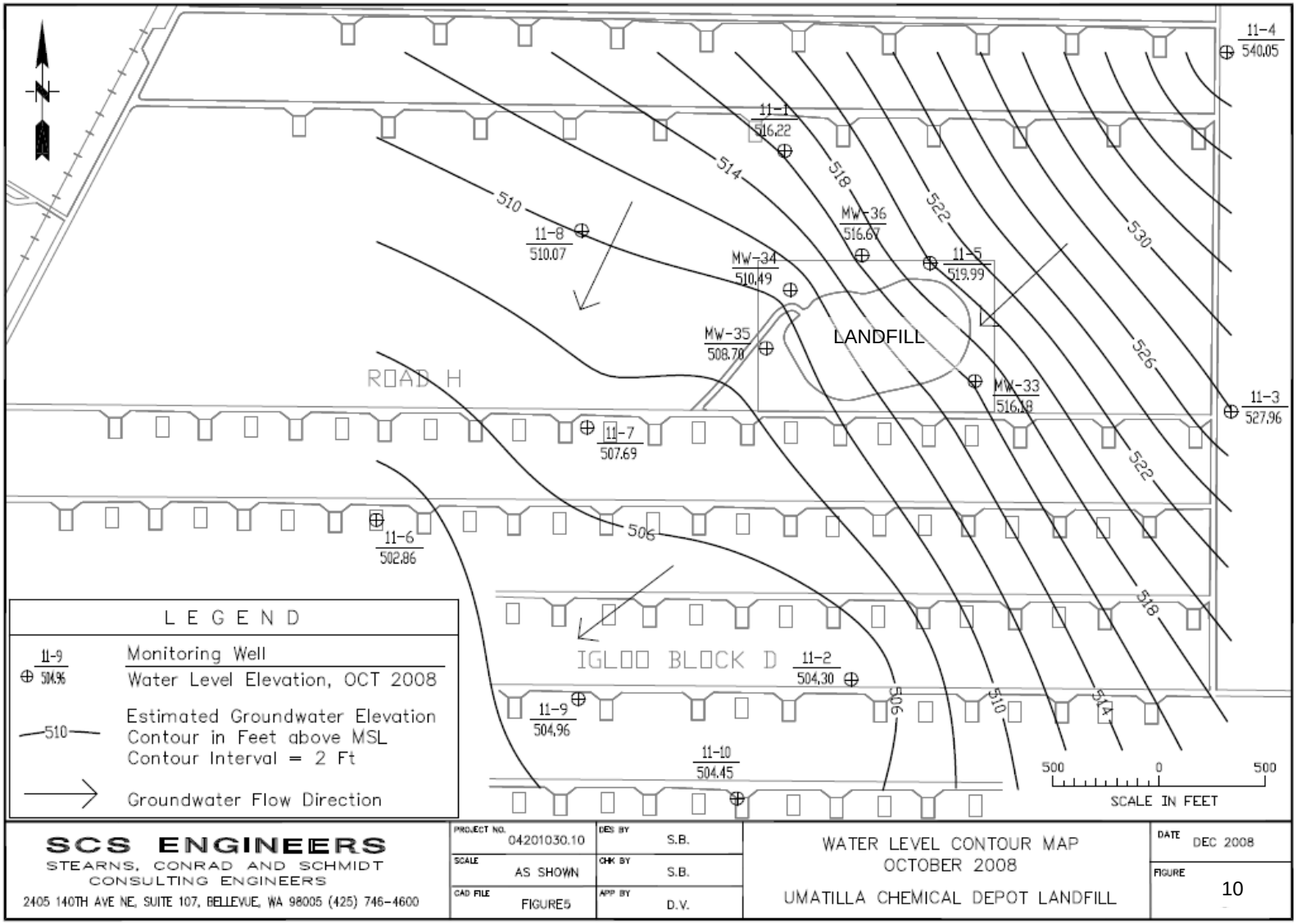


Figure 10. Landfill OU Site Map

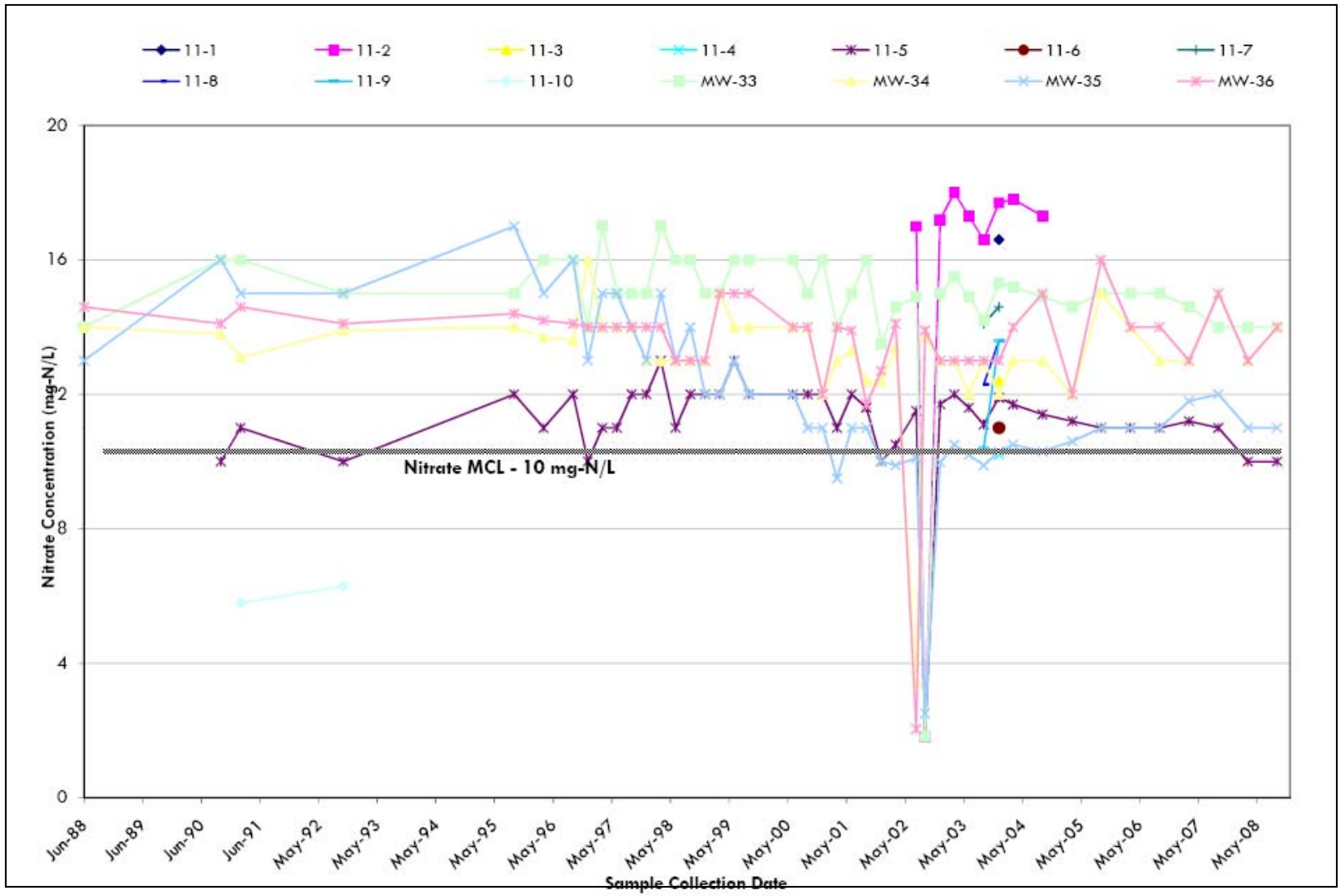


Figure 11. Historical Nitrate Concentrations in Groundwater, Landfill OU

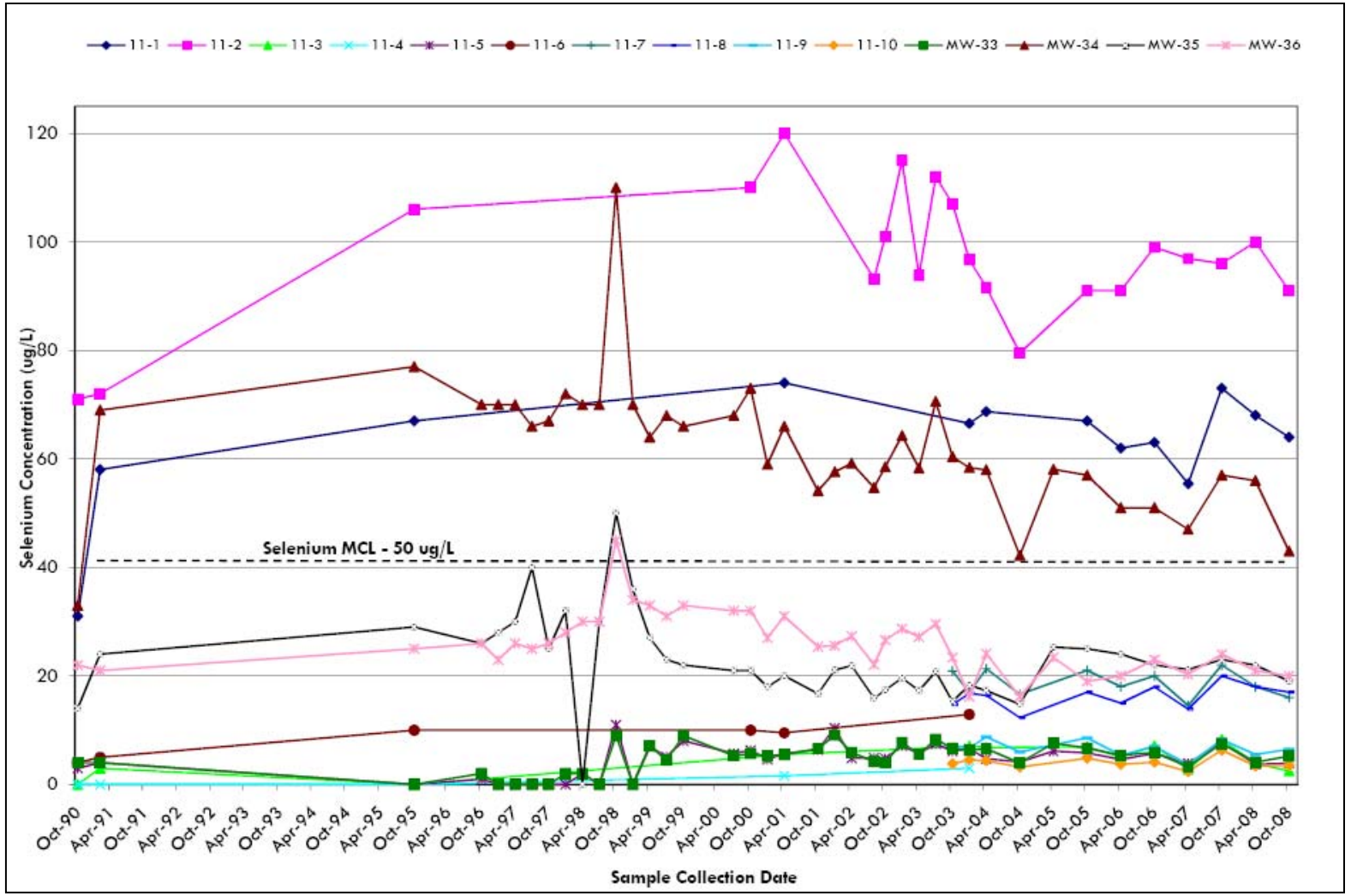


Figure 12. Historical Selenium Concentrations in Groundwater, Landfill OU

Attachment 1

List of Documents Reviewed

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Army, 1992a. *Final Remedial Investigation Report for the Umatilla Depot Activity* Hermiston, Oregon, prepared by Dames and Moore, 1992.

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Army, 1992c. *Deactivation Furnace Soils Operable Unit, Record of Decision,* Umatilla Army Depot Activity, Hermiston, Oregon, December 1992.

Army, 1992d. *Active Landfill Operable Unit, Record of Decision,* Umatilla Army Depot Activity, Hermiston, Oregon, December 1992.

Army, 1993. *Inactive Landfills Operable Unit, Record of Decision,* Umatilla Army Depot Activity, Hermiston, Oregon, March 1993.

Army, 1994a. *Explosives Washout Lagoons Groundwater Operable Unit, Record of Decision,* Umatilla Army Depot Activity, Hermiston, Oregon, June 1994.

Army, 1994b. *Ammunition Demolition Activity (ADA) Operable Unit, Record of Decision,* Umatilla Army Depot Activity, Hermiston, Oregon, June 1994.

Army, 1994c. *Explosives Washout Plant Operable Unit, Record of Decision,* Umatilla Army Depot Activity, Hermiston, Oregon, June 1994.

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Army, 1995. *Explosives Washout Plant Operable Unit, Explanation of Significant Difference,* Umatilla Army Depot Activity, Hermiston, Oregon, August 1995.

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Army, 1997b. *Explosives Washout Lagoons Soils Operable Unit, Explanation of Significant Difference,* Umatilla Army Depot Activity, Hermiston, Oregon, September 1997.

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EMR, 2009. *(Draft) Memorandum: Evaluation of Performance Benefits of Pulse Pumping, Umatilla Chemical Depot Explosives Washout Lagoons Pump and Treat System, Hermiston, Oregon.* Prepared for U.S. Army Corps of Engineers, Seattle District. October 5, 2009.

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Oregon Department of Environmental Quality (ODEQ), et al., 1995. *Groundwater Chemistry and Land Uses in the Lower Umatilla Basin Groundwater Management Area.* ODEQ, 1995.

ODEQ, 2003. Memorandum from Bruce Hope, LQ/XP, to Brian McClure, ER " *Acceptable Selenium Concentrations, Umatilla Solid Waste Landfill Groundwater*," January 21, 2003.

ODEQ, 2005. *Draft Umatilla Chemical Depot Landfill Staff Report,* March 7, 2005.

ODEQ, 2006. *2003 Lower Umatilla Basin Groundwater Management Area Synoptic Sampling Event Report.* 2006.

Plexus Scientific Corporation, 2000. *Groundwater Extraction and Treatment Effectiveness Review at Army BRAC Installations, Independent Review Team Findings and Recommendations, Umatilla Army Depot, Hermiston, Oregon.* Prepared in cooperation with ARCADIS/Geraghty & Miller and prepared for Umatilla Chemical Depot and Army Environmental Center, February 15, 2000.

SCS Engineers & EMR Corporation, (SCS & EMR) 2009. *(Draft) Pulse Pumping Optimization Evaluation, August, 2009 Pulse Pumping Event. Umatilla Chemical Depot Explosives Washout Lagoons Pump and Treat System, Hermiston, Oregon.* Prepared for U.S. Army Corps of Engineers, Seattle District. October 2009.

SCS 2009. *Explosive Washout Lagoons Pump and Treat System Enhancement Study, Umatilla Chemical Depot, Hermiston, Oregon.* Prepared for U.S. Army Corps of Engineers, Seattle District. April 2009.

USACE, 1998a. *Explosives Washout Lagoons Soils Operable Unit, Remedial Action Report,* U.S. Army Corps of Engineers, Seattle District, September 1998.

USACE, 1998b. *Deactivation Furnace Soils Operable Unit, Remedial Action Report,* U.S. Army Corps of Engineers, Seattle District, April 1998.

USACE, 1998c. *Miscellaneous Sites Operable Unit, Remedial Action Report,* U.S. Army Corps of Engineers, Seattle District, May 1998.

USACE, 1999. *Treatment Plant O&M, Contaminated Groundwater Remediation, Explosives Washout Lagoons (review draft),* U.S. Army Corps of Engineers, Seattle District, February 1999.

USACE, 2003a. *Project Closeout Report: Contaminated Soil Remediation Ammunition Demolition Area Sites 19E/F, Umatilla Chemical Depot, Hermiston, Oregon,* prepared for the US Army Corps of Engineers-Seattle District by Garry Struthers Associates, Inc., January 2003.

USACE, 2003b. *Umatilla Chemical Depot Landfill Remedial Investigation Work Plan,* U.S. Army Corps of Engineers, Seattle District, July 2003.

USACE, 2003c. *Final Engineering Evaluation/Cost Analysis Site 39, Umatilla Chemical Depot, Morrow and Umatilla Counties, Oregon, Revision 1*, prepared for the US Army Corps of Engineers-Seattle District by Parsons, October 2003.

USACE, 2004a. *2003 Annual Groundwater Monitoring Report for the Umatilla Chemical Depot Landfill*, prepared for the U.S. Army Corps of Engineers, Seattle District by SCS Engineers, January 7, 2004

USACE, 2004b. *January 2004 Landfill Environmental Monitoring Data Report for the Umatilla Chemical Depot Landfill*, prepared for the U.S. Army Corps of Engineers, Seattle District by SCS Engineers, March 1, 2004.

USACE, 2004c. *April 2004 Landfill Environmental Monitoring Data Report for the Umatilla Chemical Depot Landfill*, prepared for the U.S. Army Corps of Engineers, Seattle District by SCS Engineers, June 10, 2004.

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USACE, 2005c, *2004 Annual Monitoring Report for the Explosives Washout Lagoons Groundwater Treatment*, prepared for the U.S. Army Corps of Engineers, Seattle District by SCS Engineers, May 2005

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USACE, 2006b. *Independent Technical Review Exit Strategy Development Washout Lagoons Pump and Treat Site, Umatilla Chemical Depot, Hermiston, OR (Final Draft Report).* Prepared by US Army Corps of Engineers Hazardous, Toxic, and Radioactive Waste Center of Expertise, December 2006.

USACE, 2007. *Updated Environmental Monitoring Plan for the Umatilla Chemical Depot Closed Landfill*, U.S. Army Corps of Engineers, Seattle District, February 5, 2007.

USACE, 2008a. *2006-2007 Annual Monitoring Report for the Explosives Washout Lagoons Groundwater Treatment*, prepared for the U.S. Army Corps of Engineers, Seattle District by SCS Engineers, March 2008.

USACE, 2008b. *Exit Brief Memorandum, Umatilla Chemical Depot, Site 39, QA Function Range*, prepared for the U.S. Army Corps of Engineers, Seattle District by Bay West, Inc, November 14, 2008.

USACE 2008c. *2007 Annual Groundwater Monitoring Report for the Umatilla Chemical Depot Landfill*, prepared for the U.S. Army Corps of Engineers, Seattle District by SCS Engineers, March 14, 2008.

USACE 2008d. *2008 Annual Groundwater Monitoring Report for the Umatilla Chemical Depot Landfill*, prepared for the U.S. Army Corps of Engineers, Seattle District by SCS Engineers, December 12, 2008.

USACE, 2009a. *2008 Annual Monitoring Report for the Explosives Washout Lagoons Groundwater Treatment*, prepared for the U.S. Army Corps of Engineers, Seattle District by SCS Engineers, January 2009.

USACE, 2009b. *Explosives Washout Lagoons Pump and Treat System Enhancement Study*, prepared for the U.S. Army Corps of Engineers, Seattle District by SCS Engineers, April 2009.

United States Environmental Protection Agency (USEPA), 1999. *Region 10 Final Policy on the Use of Institutional Controls at Federal Facilities*, U.S.EPA Region 10, Seattle, WA, May 3, 1999.

USEPA, 2001. *Comprehensive Five-Year Review Guidance EPA 540-R-01-007*, June 2001.

Attachment 2

Site Inspection Checklist

SITE INSPECTION CHECKLIST

I. SITE INFORMATION	
Site name: Umatilla Chemical Depot	**Date of inspection: 19 August 2009**
Location and Region: Hermiston, OR **EPA Region 10**	**EPA ID: OR6213820917**
Agency, office, or company leading the five-year review: US Army	**Weather/temperature: Sunny/ 95-deg F**

Remedy Includes: (Check all that apply)

- ☒ Landfill cover/containment
- ☒ Access controls
- ☒ Institutional controls
- ☒ Groundwater pump and treatment
- ☐ Surface water collection and treatment
- ☐ Other_____
- ☐ Monitored natural attenuation
- ☐ Groundwater containment
- ☐ Vertical barrier walls

Attachments: ☒ Inspection team roster ☐ Site map attached

Site Inspection Team: Mark Daugherty, UMCD BRAC Environmental Coordinator
Jefferey Powers, US Army Corps of Engineers, Seattle District Hydrogeologist

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** _____ _____ _____
   Name Title Date
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☐ Report attached _____

2. **O&M staff** _____ _____ _____
   Name Title Date
   Interviewed ☐ at site ☐ at office ☐ by phone Phone no. _____
   Problems, suggestions; ☐ Report attached _____

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____
_____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; G Report attached _____
_____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; G Report attached _____
_____

Agency _____
Contact _____ _____ _____ _____
Name Title Date Phone no.
Problems; suggestions; ☐ Report attached _____
_____

4. **Other interviews** (optional) ☐ Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Documents**

☒ O&M manual	☒ Readily available	☒ Up to date	☐ N/A
☒ As-built drawings	☒ Readily available	☒ Up to date	☐ N/A
☒ Maintenance logs	☒ Readily available	☒ Up to date	☐ N/A

Remarks: All documents kept in USACE Seattle District office, copies of select documents kept at UMCD BRAC Environmental Coordinator (BEC) office.

2. **Site-Specific Health and Safety Plan** ☒ Readily available ☒ Up to date ☐ N/A
☒ Contingency plan/emergency response plan ☒ Readily available ☒ Up to date ☐ N/A
Remarks: All documents kept in USACE Seattle District office, copies of select documents kept at UMCD BEC office.

3. **O&M and OSHA Training Records** ☒ Readily available ☐ Up to date ☐ N/A
Remarks: Records kept at BEC offices.

4. **Permits and Service Agreements**

Air discharge permit	☐ Readily available	☐ Up to date	☒ N/A
Effluent discharge	☐ Readily available	☐ Up to date	☒ N/A
Waste disposal, POTW	☐ Readily available	☐ Up to date	☒ N/A
Other permits_____	☐ Readily available	☐ Up to date	☒ N/A

Remarks: No CERCLA permits are required for Umatilla Federal Facility CERCLA activities.

5. **Gas Generation Records** ☐ Readily available ☐ Up to date ☒ N/A
Remarks: Landfill was historically monitored for gas; no gas generated due to non-organic nature of landfill contents.

6. **Settlement Monument Records** ☐ Readily available ☐ Up to date ☒ N/A
Remarks: Settlement is not a concern for any open CERCLA sites.
_____

7. **Groundwater Monitoring Records** ☒ Readily available ☒ Up to date ☐ N/A
Remarks: All documents kept in USACE Seattle District office, copies of select documents kept at UMCD BEC office.

8. **Leachate Extraction Records** ☐ Readily available ☐ Up to date ☒ N/A
Remarks: No leachate generated at any of open CERCLA sites.
_____

9. **Discharge Compliance Records**

Air	☐ Readily available	☐ Up to date	☒ N/A
Water (effluent)	☐ Readily available	☐ Up to date	☒ N/A

Remarks_____
_____

10. **Daily Access/Security Logs** ☒ Readily available ☒ Up to date ☐ N/A
Remarks: Separate security logs maintained as a function of the military mission at UMCD. These include access to CERCLA sites at the installation.

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for State
☐ PRP in-house ☐ Contractor for PRP
☐ Federal Facility in-house ☒ Contractor for Federal Facility
☐ Other_____

Currently USACE Seattle District and their contractors (EMR, Inc. and SCS Engineers)

2. **O&M Cost Records (Explosives Washout Lagoons Groundwater LTM/LTO)**

☐ Readily available ☒ Up to date
☐ Funding mechanism/agreement in place
Original O&M cost estimate_____ ☐ Breakdown attached

Total annual cost by year for review period if available

From	Oct 2004 Date	To	Sep 2005 Date	$264,700 contract/ $185,100 labor & misc Total cost
From	Oct 2005 Date	To	Sep 2006 Date	$119,300 contract/ $181,600 labor & misc Total cost
From	Oct 2006 Date	To	Sep 2007 Date	$400(? Will check on this figure) contract/ $118,700 labor & misc Total cost
From	Oct 2007 Date	To	Sep 2008 Date	$320,600 Total cost
From	Oct 2008 Date	To	Sep 2009 Date	$442,000 Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: _____
Non-routine maintenance conducted during a system outage between Oct 2006 and May 2007 included: Installation of an uninterruptible power supply for PLC/Alarm system, restoration of signal communication to remote extraction wells 1 and 3, replacement of heater elements in treatment plant, replacement of the pre-lube solenoid valve at extraction well 4, remove rust and repaint pipe supports and piping, replacement of three extraction well covers to include ventilation, and replacement of pumps at extraction wells 1 and 3. These items contributed to greater than average O&M costs during this period.

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☒ Gates secured ☒ N/A

Remarks: Fences at UMCD required for installation security. Inspected daily and well maintained.

_____

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☐ N/A

Remarks: Restricted access signs facing outward on UMCD perimeter fencing every 500-ft.

_____

C. Institutional Controls (ICs)

1. **Implementation and enforcement**

Site conditions imply ICs not properly implemented ☐ Yes ☒ No ☐ N/A
Site conditions imply ICs not being fully enforced ☐ Yes ☒ No ☐ N/A

Type of monitoring (*e.g.*, self-reporting, drive by): Self reporting & armed military patrols
Frequency: Patrols of UMCD perimeter conducted hourly
Responsible party/agency: US Army
Contact Mark Daugherty BRAC Environmental Coordinator 8/19/09 (541) 564-5294
Name Title Date Phone no.

Reporting is up-to-date ☒ Yes ☐ No ☐ N/A
Reports are verified by the lead agency ☒ Yes ☐ No ☐ N/A

Specific requirements in deed or decision documents have been met ☒ Yes ☐ No ☐ N/A
Violations have been reported ☐ Yes ☐ No ☒ N/A
Other problems or suggestions: ☐ Report attached
None.

2. **Adequacy** ☒ ICs are adequate ☐ ICs are inadequate ☐ N/A
Remarks

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident
Remarks

2. **Land use changes on site** ☒ N/A
Remarks: None. Only activity at any of open CERCLA sites is groundwater extraction and treatment system at Explosives Washout Lagoons Groundwater OU.

3. **Land use changes off site** ☒ N/A
Remarks: As before, UMCD surrounded by highways and agriculture.

VI. GENERAL SITE CONDITIONS

A. Roads ☒ Applicable ☐ N/A

1. **Roads damaged** ☐ Location shown on site map ☐ Roads adequate ☐ N/A
Remarks: While roads are not strictly a component of any remedy, several dirt/gravel and paved roadways are required to traverse to and from sites on the installation. Roads generally in good condition and drivable without needing 4 wheel-drive.

B. Other Site Conditions

Remarks _____

_____

_____

_____

_____

_____

VII. LANDFILL COVERS ☒ Applicable ☐ N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map ☒ Settlement not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

2. **Cracks** ☐ Location shown on site map ☒ Cracking not evident
   Lengths_____ Widths_____ Depths_____
   Remarks_____
   _____

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

4. **Holes** ☐ Location shown on site map ☒ Holes not evident
   Areal extent_____ Depth_____
   Remarks: Several small mounds of earth were visible on the northwest corner of the Landfill. These are possibly the result of animal burrow activity, although no holes were evident.

5. **Vegetative Cover** ☒ Grass ☒ Cover properly established ☒ No signs of stress
   ☐ Trees/Shrubs (indicate size and locations on a diagram)
   Remarks: No trees present. Patchy native grasses present and similar to native vegetation adjacent to Landfill.

6. **Alternative Cover (armored rock, concrete, etc.)** ☒ N/A
   Remarks_____
   _____

7. **Bulges** ☐ Location shown on site map ☒ Bulges not evident
   Areal extent_____ Height_____
   Remarks_____
   _____

8. **Wet Areas/Water Damage** ☒ Wet areas/water damage not evident
- ☐ Wet areas ☐ Location shown on site map Areal extent_____
- ☐ Ponding ☐ Location shown on site map Areal extent_____
- ☐ Seeps ☐ Location shown on site map Areal extent_____
- ☐ Soft subgrade ☐ Location shown on site map Areal extent_____

Remarks_____

9. **Slope Instability** ☐ Slides ☐ Location shown on site map ☒ No evidence of slope instability
Areal extent_____
Remarks_____

B. Benches ☐ Applicable ☒ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

C. Letdown Channels ☐ Applicable ☒ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

D. Cover Penetrations ☐ Applicable ☒ N/A

E. Gas Collection and Treatment ☐ Applicable ☒ N/A

F. Cover Drainage Layer ☐ Applicable ☒ N/A

G. Detention/Sedimentation Ponds ☐ Applicable ☒ N/A

H. Retaining Walls ☐ Applicable ☒ N/A

I. Perimeter Ditches/Off-Site Discharge ☒ Applicable ☐ N/A

1. **Siltation** ☐ Location shown on site map ☒ Siltation not evident
Areal extent_____ Depth_____
Remarks: Rock-armored perimeter ditch surrounding Landfill to keep runoff from pooling on cap.

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
☒ Vegetation does not impede flow
Areal extent_____ Type_____
Remarks: Some grass present between cobbles of rock armor.

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident
Areal extent_____ Depth_____
Remarks_____

4. **Discharge Structure** ☐ Functioning ☒ N/A
Remarks_____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

2. **Performance Monitoring** Type of monitoring_____
   ☐ Performance not monitored
   Frequency_____ ☐ Evidence of breaching
   Head differential_____
   Remarks_____
   _____

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☒ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
   ☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A
   Remarks: Did not physically locate and inspect all equipment; reportedly in good operating condition.
   _____
   _____

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
   ☒ Good condition ☐ Needs Maintenance
   Remarks: Did not physically locate and inspect all equipment; reportedly in good operating condition.
   _____

3. **Spare Parts and Equipment**
   ☐ Readily available ☒ Good condition ☐ Requires upgrade ☐ Needs to be provided
   Remarks: Did not physically locate and inspect spare equipment; reportedly in good operating condition.
   _____

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

1. **Collection Structures, Pumps, and Electrical**
   ☐ Good condition ☐ Needs Maintenance
   Remarks_____
   _____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
   ☐ Good condition ☐ Needs Maintenance
   Remarks_____
   _____

3. **Spare Parts and Equipment**
   ☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided
   Remarks_____
   _____

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
   - ☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
   - ☐ Air stripping ☒ Carbon adsorbers
   - ☐ Filters_____
   - ☐ Additive (*e.g.*, chelation agent, flocculent)_____
   - ☐ Others_____
   - ☒ Good condition ☐ Needs Maintenance
   - ☐ Sampling ports properly marked and functional
   - ☐ Sampling/maintenance log displayed and up to date
   - ☐ Equipment properly identified
   - ☐ Quantity of groundwater treated annually_____
   - ☐ Quantity of surface water treated annually_____

   Remarks_____

2. **Electrical Enclosures and Panels** (properly rated and functional)
   - ☐ N/A ☒ Good condition ☐ Needs Maintenance

   Remarks: Not physically inspected but reportedly in good condition.

3. **Tanks, Vaults, Storage Vessels**
   - ☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance

   Remarks: Not physically inspected but reportedly in good condition.

4. **Discharge Structure and Appurtenances**
   - ☐ N/A ☒ Good condition ☐ Needs Maintenance

   Remarks: All below ground; reportedly in good condition.

5. **Treatment Building(s)**
   - ☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair
   - ☐ Chemicals and equipment properly stored

   Remarks: Repaired and painted pipe supports since last FYR.

6. **Monitoring Wells** (pump and treatment remedy)
   - ☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
   - ☐ All required wells located ☐ Needs Maintenance ☐ N/A

   Remarks_____

D. Monitoring Data

1. Monitoring Data
   - ☒ Is routinely submitted on time ☒ Is of acceptable quality

2. Monitoring data suggests:
   - ☒ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining

D. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)

☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ All required wells located ☐ Needs Maintenance ☒ N/A
Remarks_____
_____

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).

Pump and treat remedy at Explosives Washout Lagoons Groundwater OU purpose is to contain and capture explosives plumes. Remedy is functioning to contain and capture; however, mass captured is declining, and steps are being taken in accordance with ROD to modify system to enhance effectiveness such as pulse pumping. All other remedies are functioning as designed.

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.

Pump and treat remedy at EWL GW OU is protective in the short-term because there are no receptors for groundwater, and the system is operating to contain and capture. Long-term protectiveness is expected upon completion

C.	Early Indicators of Potential Remedy Problems
	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. None.

D.	Opportunities for Optimization
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. Pump and treat: No known opportunities for optimization of monitoring. Currently evaluating pulse pumping operation strategy to remove more mass and/or reduce cost of operation to make remedy more cost effective.

Attachment 3

Site Inspection Photographs

Photo 1. Ammunition Demolition Activity (ADA) OU (burned due to recent lightning strike).

Photo 2. ADA OU (burned due to recent lightning strike).

Photo 3. Landfill OU, facing southeast.

Photo 4. Landfill OU, armored drainage ditch.

Photo 5. Landfill OU, facing southeast.

Photo 6. Landfill OU, facing southwest.

Photo 7. Explosives Washout Lagoons (EWL) Groundwater OU, former lagoon.

Photo 8. EWL Groundwater OU, stockpile of excess treated soil.

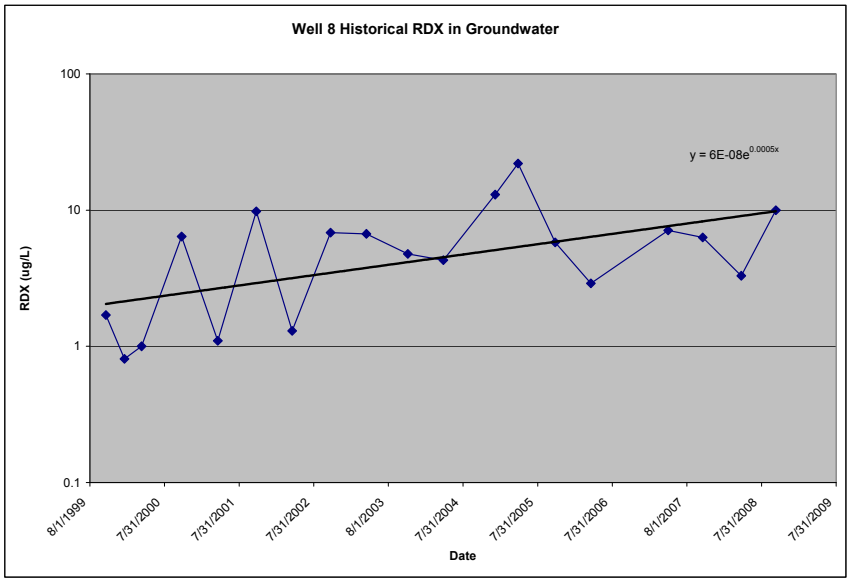
Photo 9. EWL Groundwater OU, location of former Washout Plant, facing east.

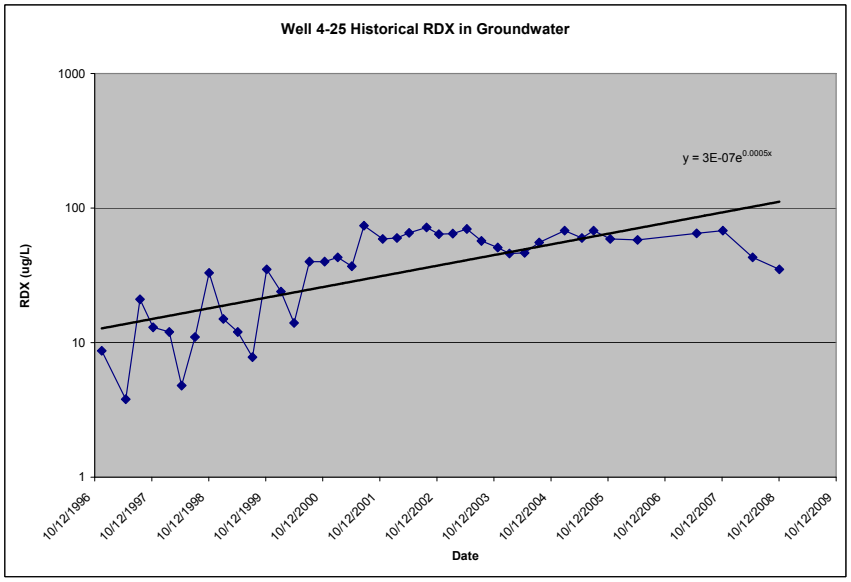
Photo 10. EWL Groundwater OU, treatment plant building.

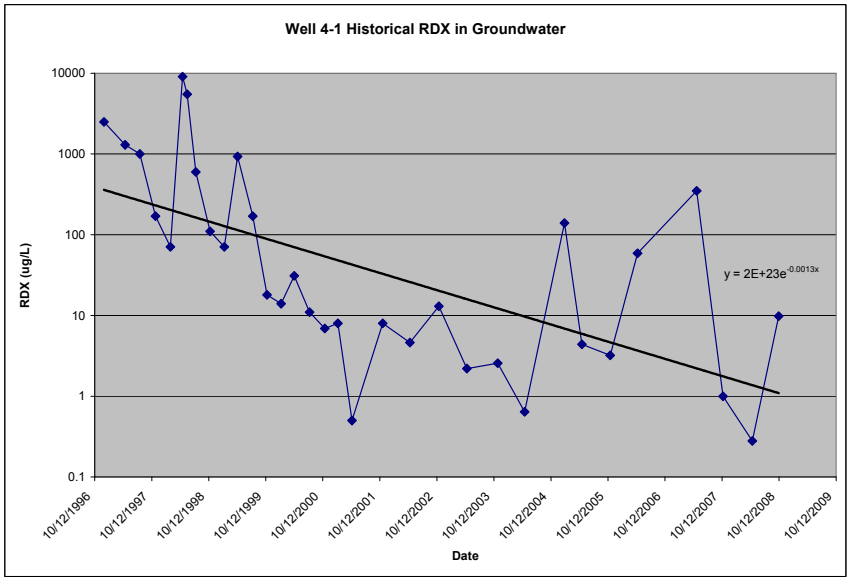
Attachment 4

RDX and TNT at EWL GW OU Monitoring Wells with Complete Time History and Concentrations Above Cleanup Goals

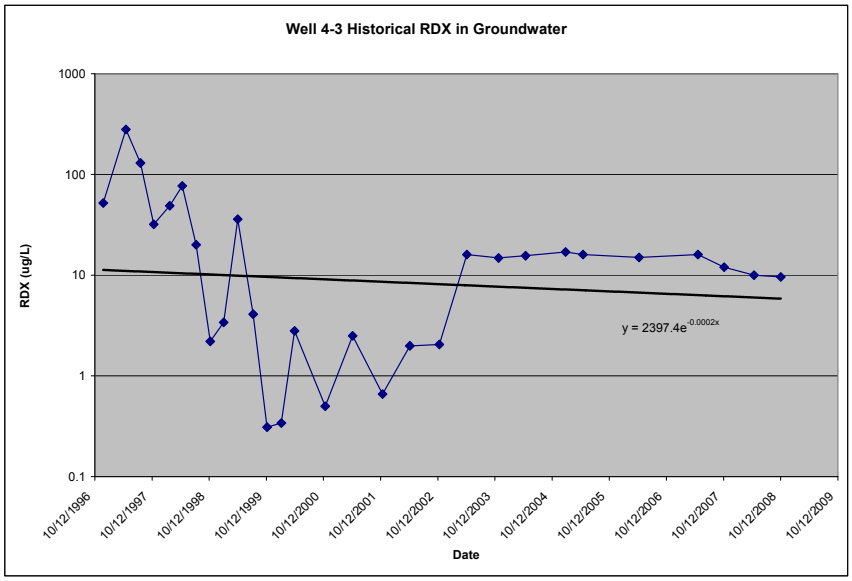
RDX

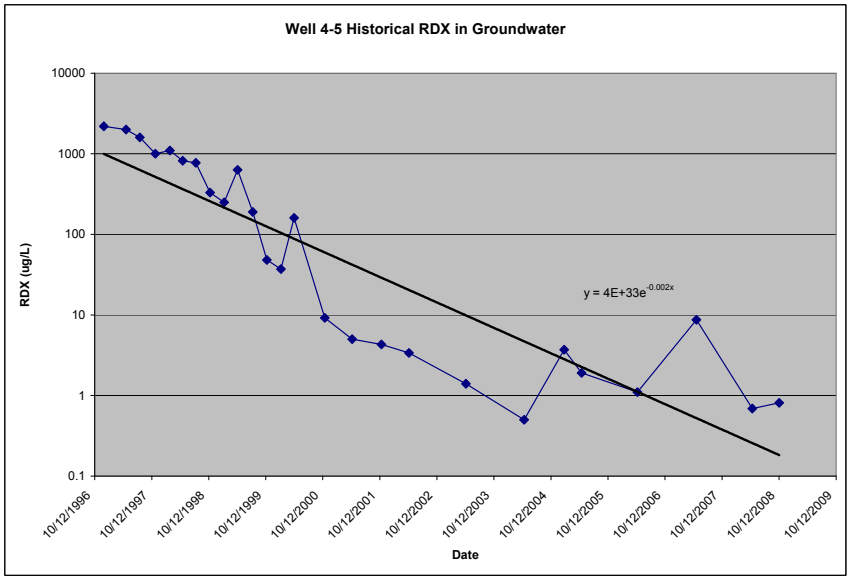

Well 8 Historical RDX in Groundwater
y = 6E-08e^0.0005x
RDX (ug/L)
100
10
1
0.1
8/1/1999
7/31/2000
7/31/2001
7/31/2002
8/1/2003
7/31/2004
7/31/2005
7/31/2006
8/1/2007
7/31/2008
7/31/2009
Date

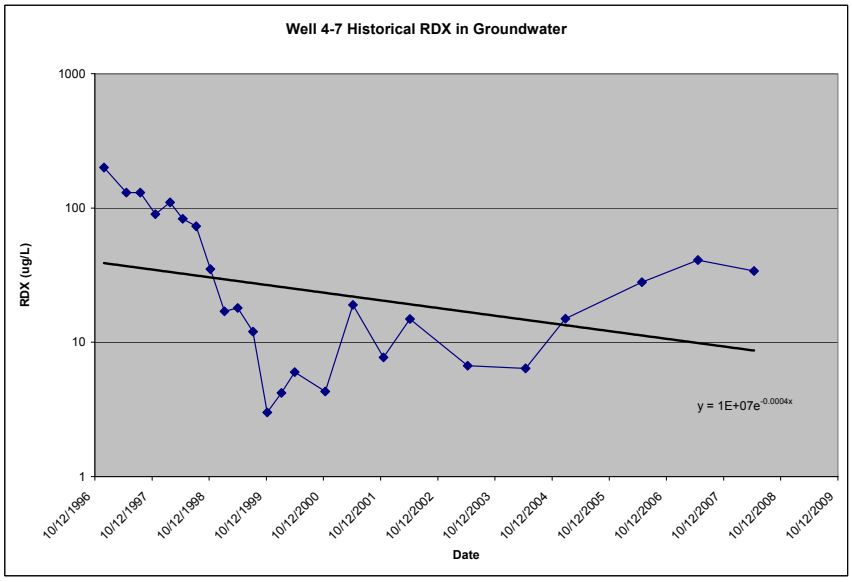

Well 4-25 Historical RDX in Groundwater
y = 3E-07e^0.0005x
RDX (ug/L)
1000
100
10
1
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date


Well 4-1 Historical RDX in Groundwater
y = 2E+23e^-0.0013x
RDX (ug/L)
10000
1000
100
10
1
0.1
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date

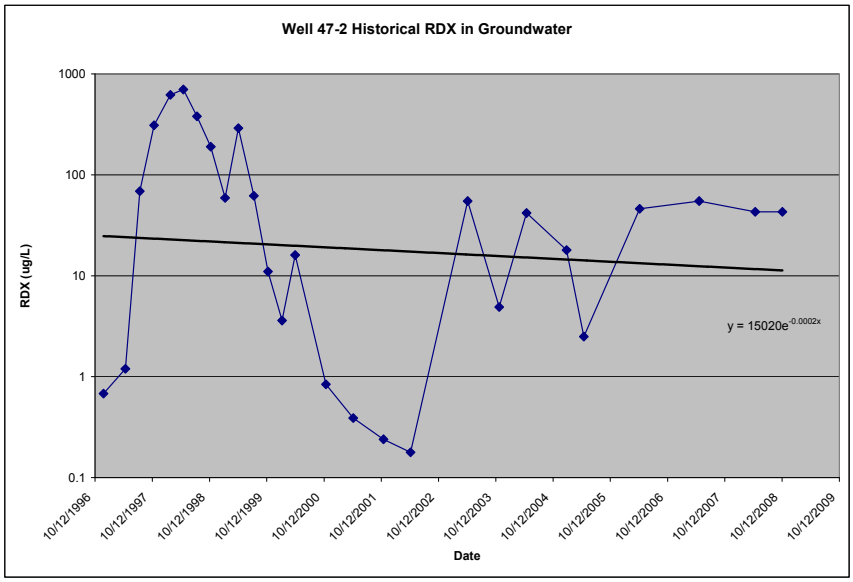
RDX

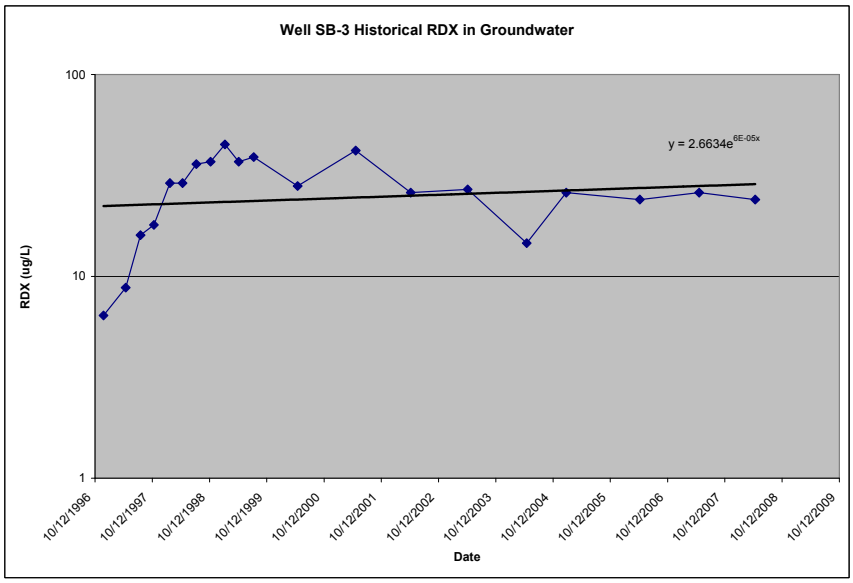

Well 4-3 Historical RDX in Groundwater
RDX (ug/L)
1000
100
10
1
0.1
y = 2397.4e-0.0002x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date

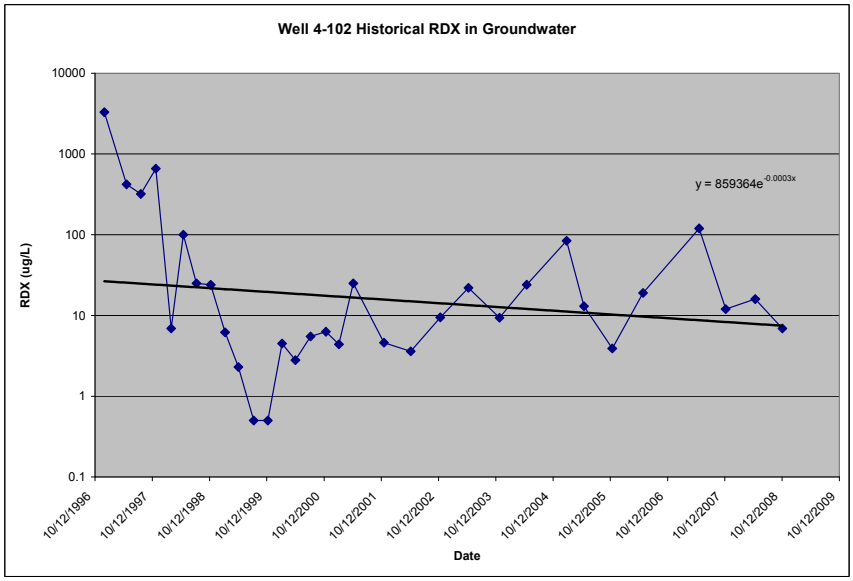

Well 4-5 Historical RDX in Groundwater
RDX (ug/L)
10000
1000
100
10
1
0.1
y = 4E+33e-0.002x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date


Well 4-7 Historical RDX in Groundwater
RDX (ug/L)
1000
100
10
1
y = 1E+07e-0.0004x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date

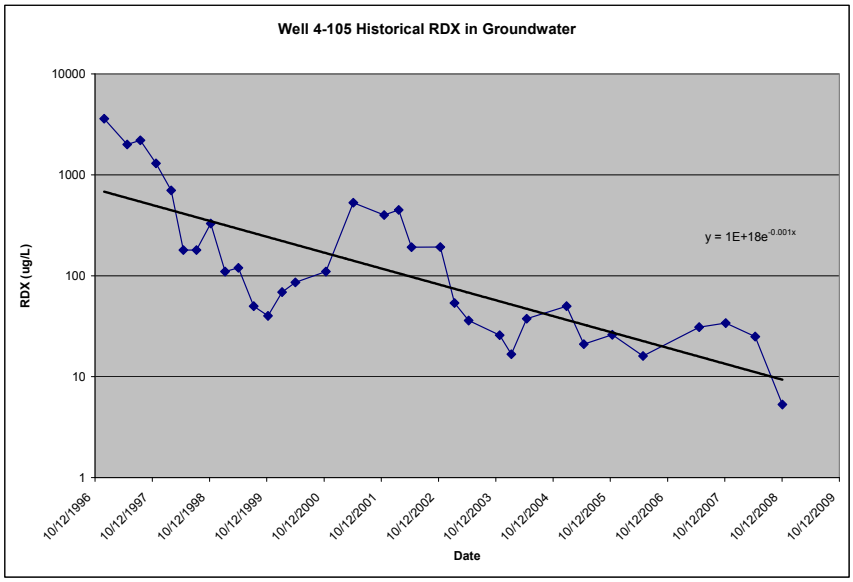
RDX

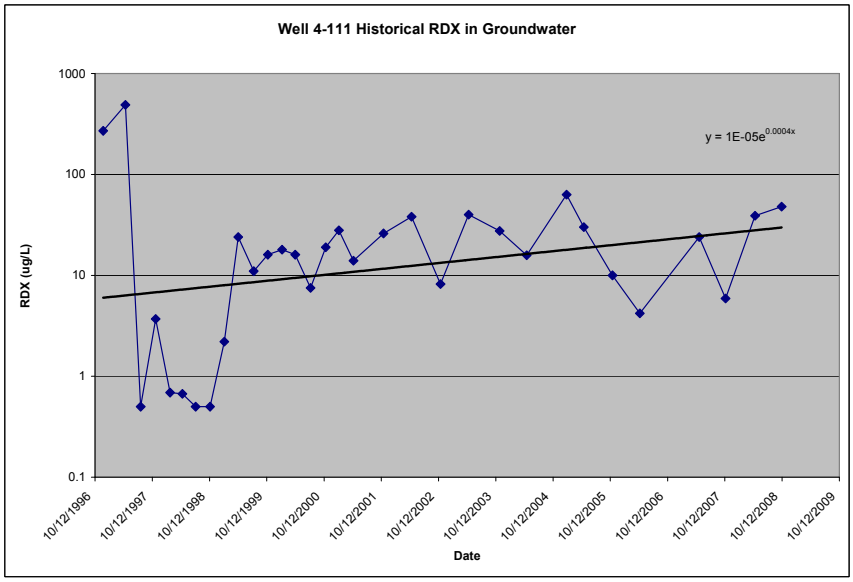

Well 47-2 Historical RDX in Groundwater
RDX (ug/L)
1000
100
10
1
0.1
y = 15020e-0.0002x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date

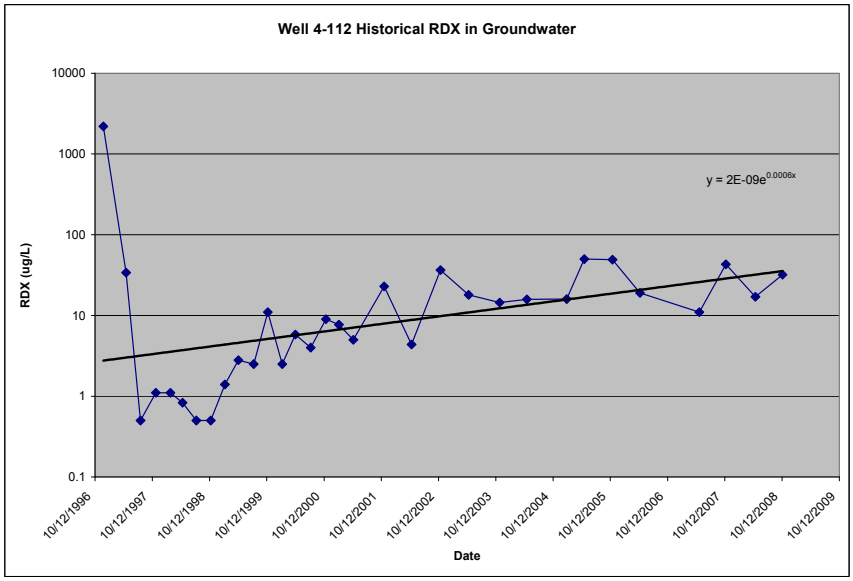

Well SB-3 Historical RDX in Groundwater
RDX (ug/L)
100
10
1
y = 2.6634e6E-05x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date


Well 4-102 Historical RDX in Groundwater
RDX (ug/L)
10000
1000
100
10
1
0.1
y = 859364e-0.0003x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date

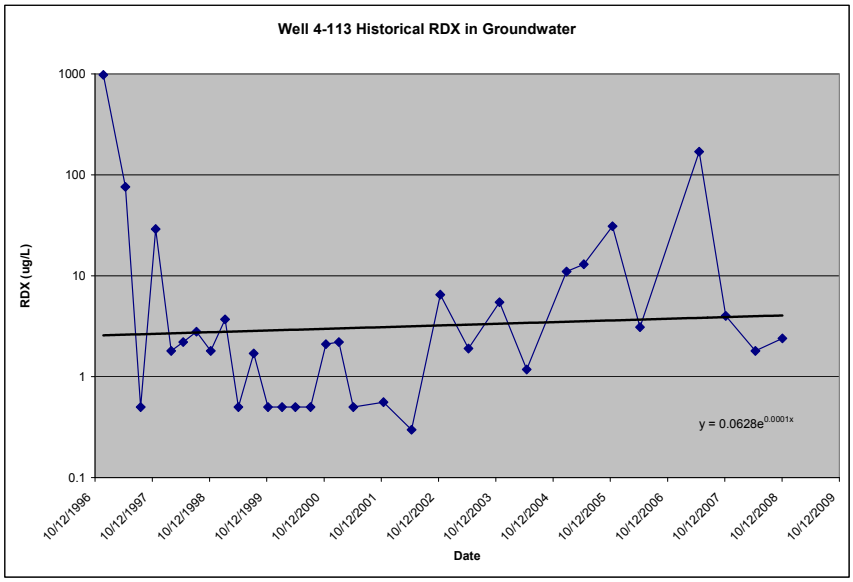
RDX

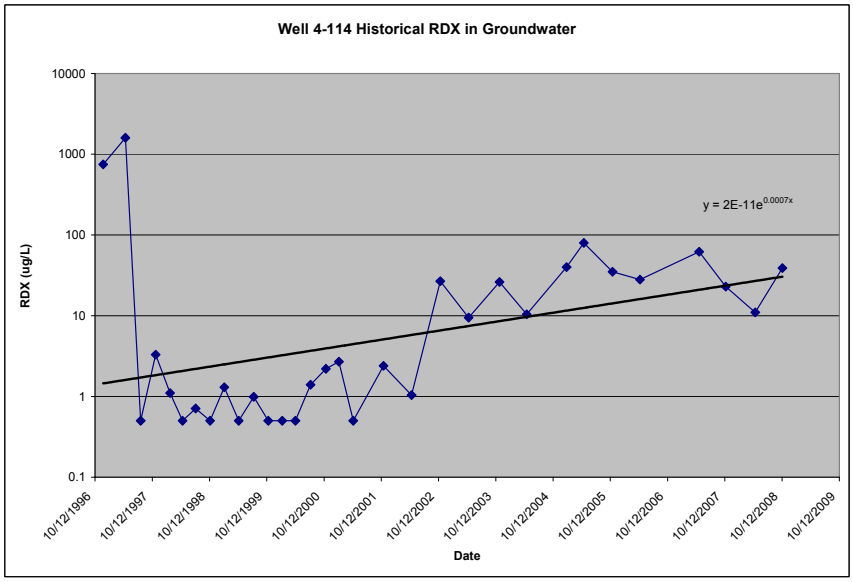

Well 4-105 Historical RDX in Groundwater
RDX (ug/L)
10000
1000
100
10
1
y = 1E+18e-0.001x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date

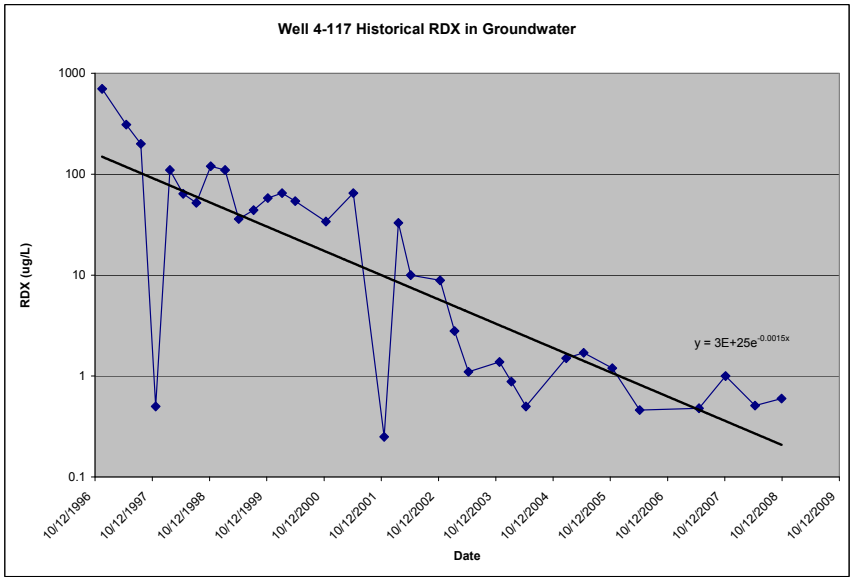

Well 4-111 Historical RDX in Groundwater
RDX (ug/L)
1000
100
10
1
0.1
y = 1E-05e0.0004x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date


Well 4-112 Historical RDX in Groundwater
RDX (ug/L)
10000
1000
100
10
1
0.1
y = 2E-09e0.0006x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date

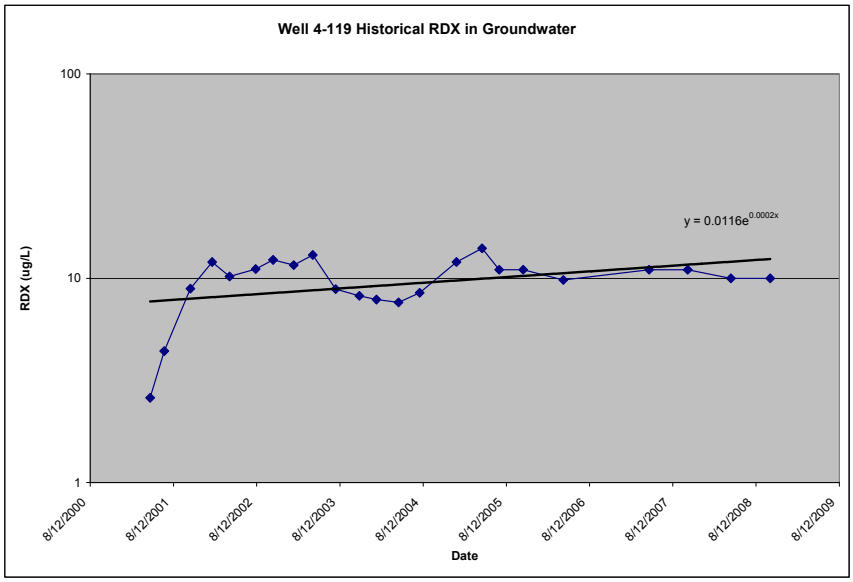
RDX

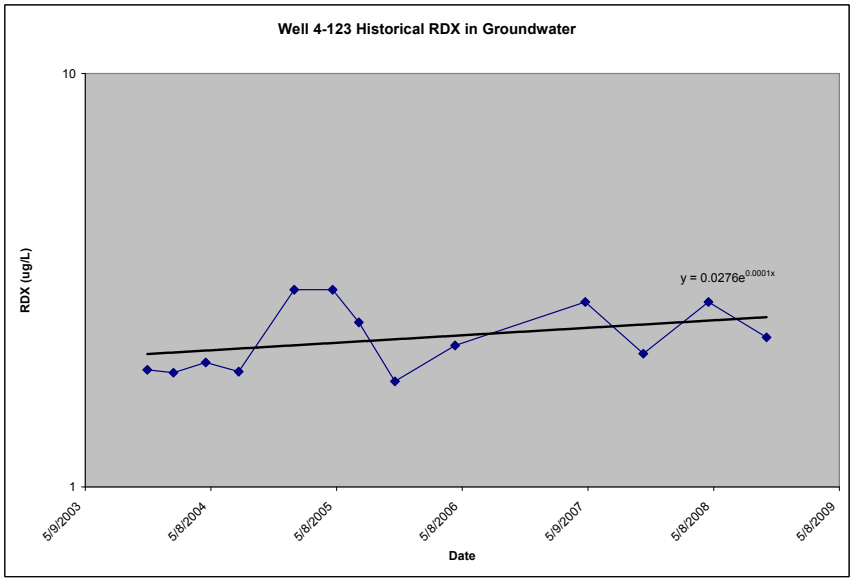

Well 4-113 Historical RDX in Groundwater
RDX (ug/L)
1000
100
10
1
0.1
y = 0.0628e^0.0001x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date

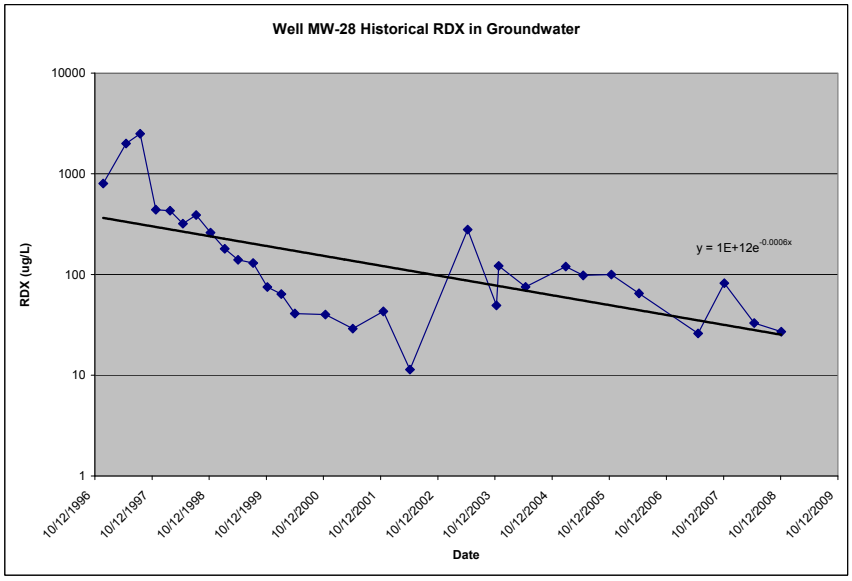

Well 4-114 Historical RDX in Groundwater
RDX (ug/L)
10000
1000
100
10
1
0.1
y = 2E-11e^0.0007x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date


Well 4-117 Historical RDX in Groundwater
RDX (ug/L)
1000
100
10
1
0.1
y = 3E+25e^-0.0015x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date

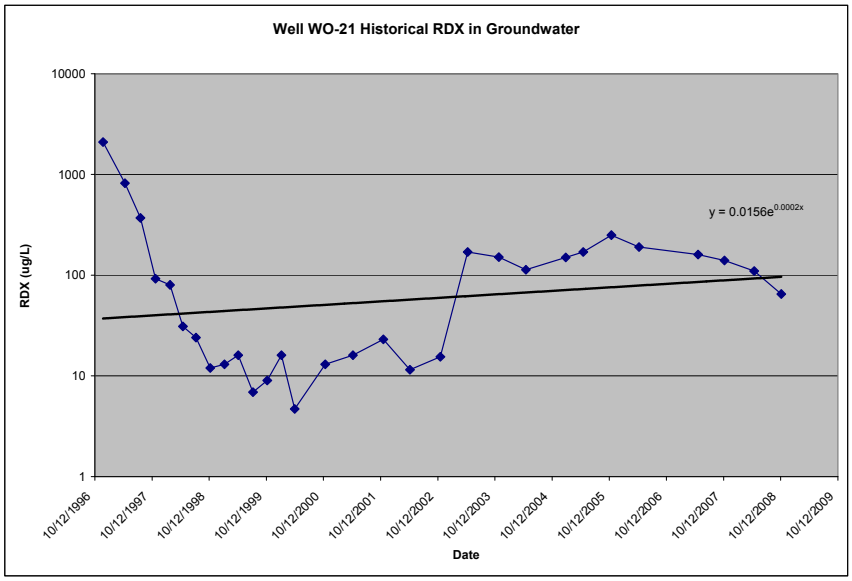
RDX

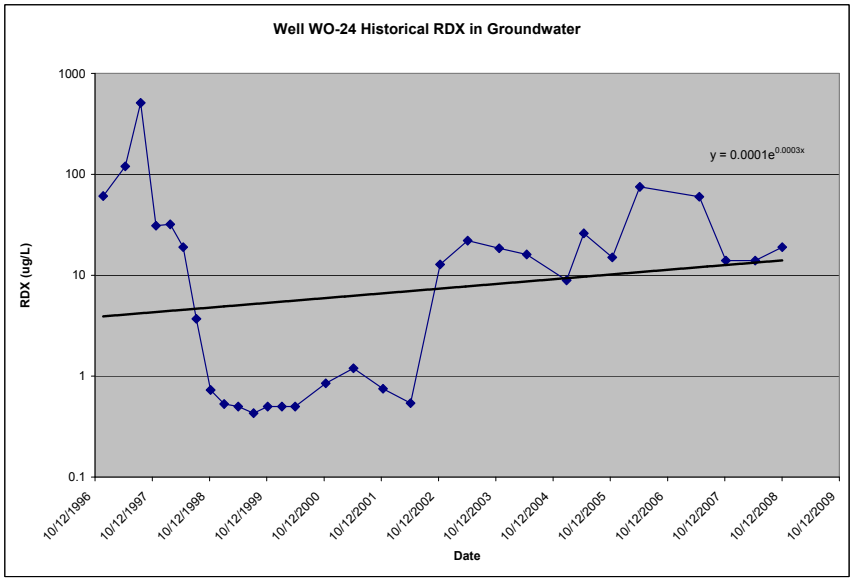

Well 4-119 Historical RDX in Groundwater
RDX (ug/L)
100
10
1
y = 0.0116e^0.0002x
8/12/2000
8/12/2001
8/12/2002
8/12/2003
8/12/2004
8/12/2005
8/12/2006
8/12/2007
8/12/2008
8/12/2009
Date


Well 4-123 Historical RDX in Groundwater
RDX (ug/L)
10
1
y = 0.0276e^0.0001x
5/9/2003
5/8/2004
5/8/2005
5/8/2006
5/9/2007
5/8/2008
5/8/2009
Date

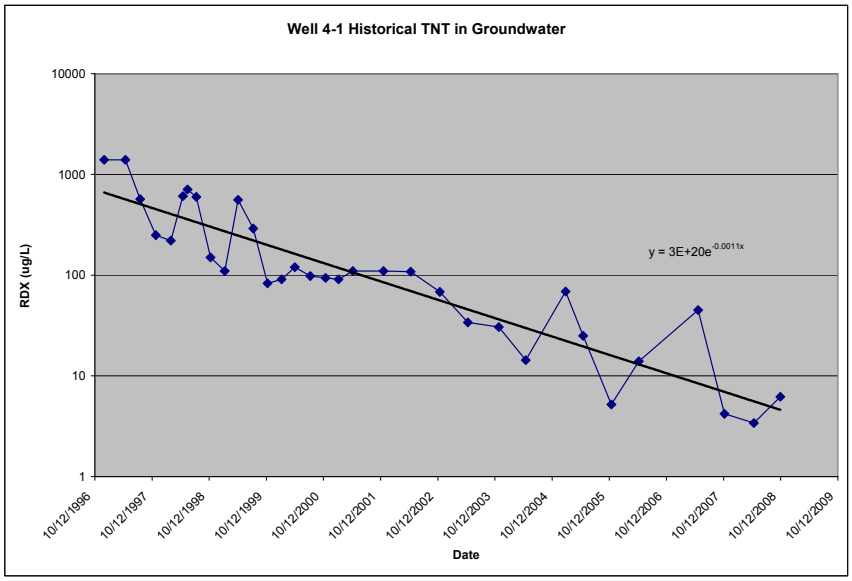

Well MW-28 Historical RDX in Groundwater
RDX (ug/L)
10000
1000
100
10
1
y = 1E+12e^-0.0006x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date

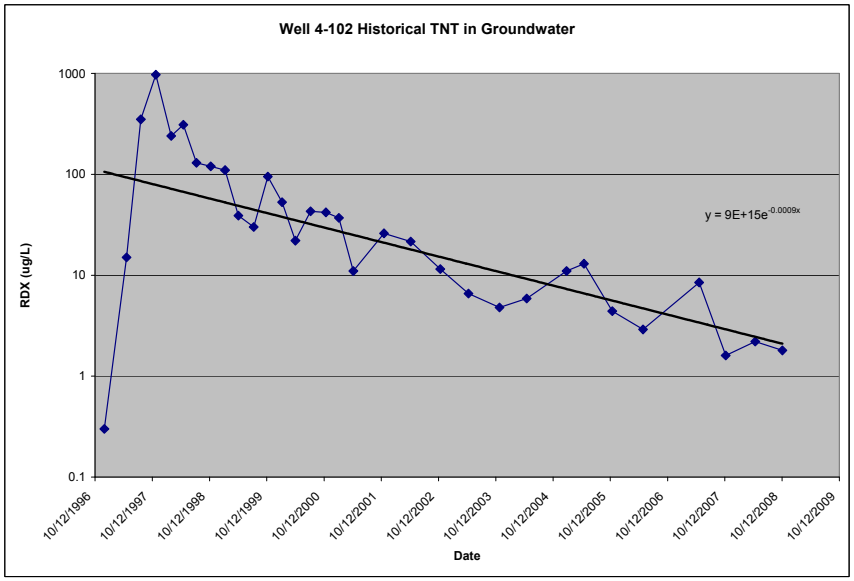
RDX

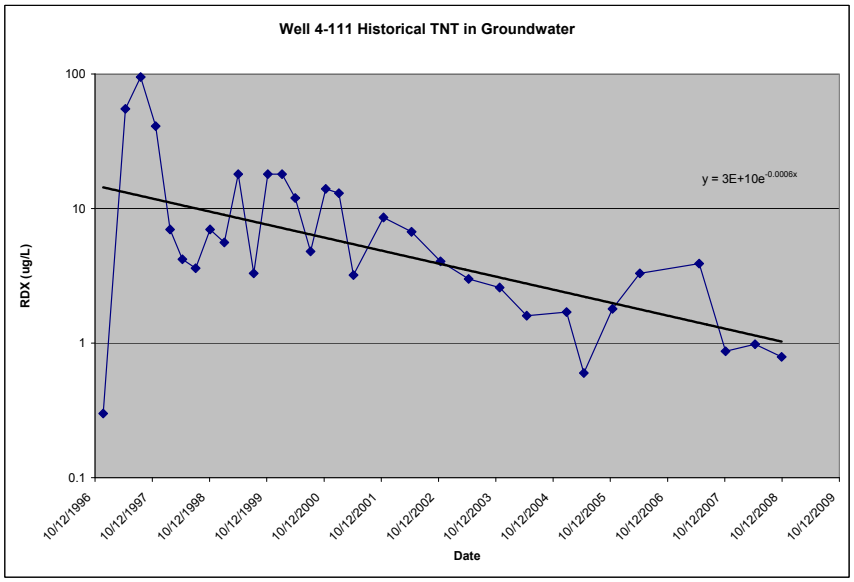

Well WO-21 Historical RDX in Groundwater
RDX (ug/L)
10000
1000
100
10
1
y = 0.0156e^0.0002x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date


Well WO-24 Historical RDX in Groundwater
RDX (ug/L)
1000
100
10
1
0.1
y = 0.0001e^0.0003x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date

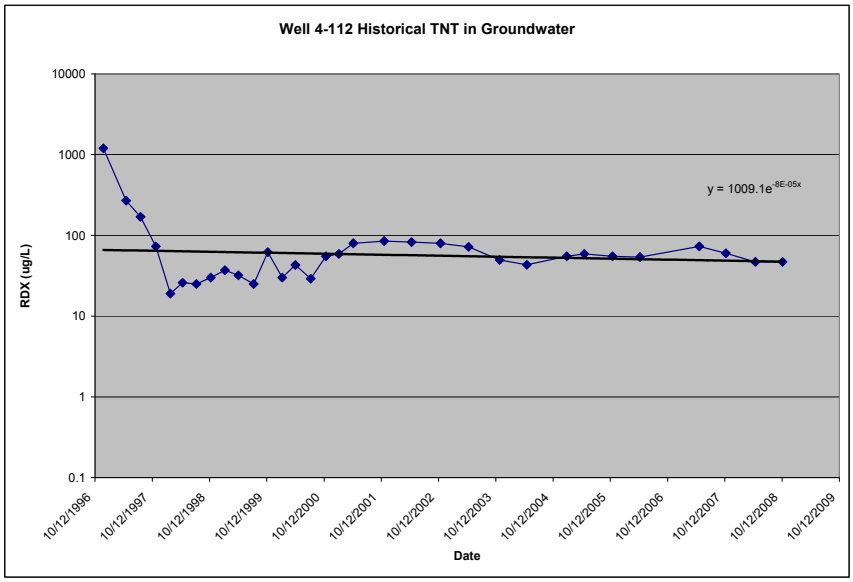
TNT

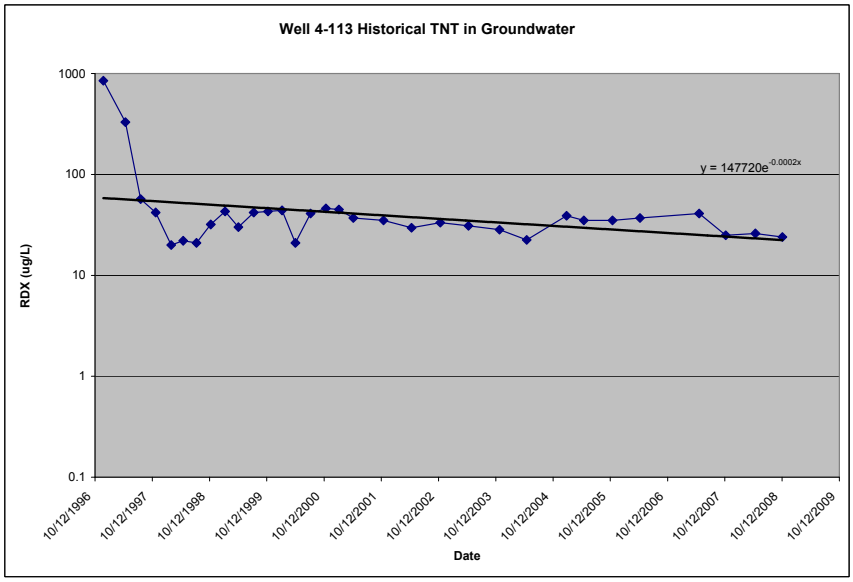

Well 4-1 Historical TNT in Groundwater
RDX (ug/L)
10000
1000
100
10
1
y = 3E+20e-0.0011x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date

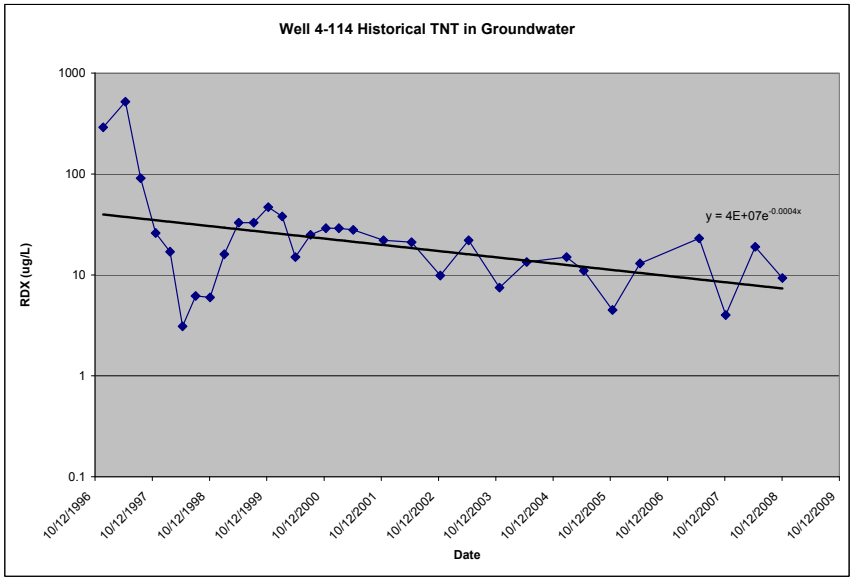

Well 4-102 Historical TNT in Groundwater
RDX (ug/L)
1000
100
10
1
0.1
y = 9E+15e-0.0009x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date


Well 4-111 Historical TNT in Groundwater
RDX (ug/L)
100
10
1
0.1
y = 3E+10e-0.0006x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date

TNT


Well 4-112 Historical TNT in Groundwater
RDX (ug/L)
10000
1000
100
10
1
0.1
y = 1009.1e-8E-05x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date


Well 4-113 Historical TNT in Groundwater
RDX (ug/L)
1000
100
10
1
0.1
y = 147720e-0.0002x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date


Well 4-114 Historical TNT in Groundwater
RDX (ug/L)
1000
100
10
1
0.1
y = 4E+07e-0.0004x
10/12/1996
10/12/1997
10/12/1998
10/12/1999
10/12/2000
10/12/2001
10/12/2002
10/12/2003
10/12/2004
10/12/2005
10/12/2006
10/12/2007
10/12/2008
10/12/2009
Date

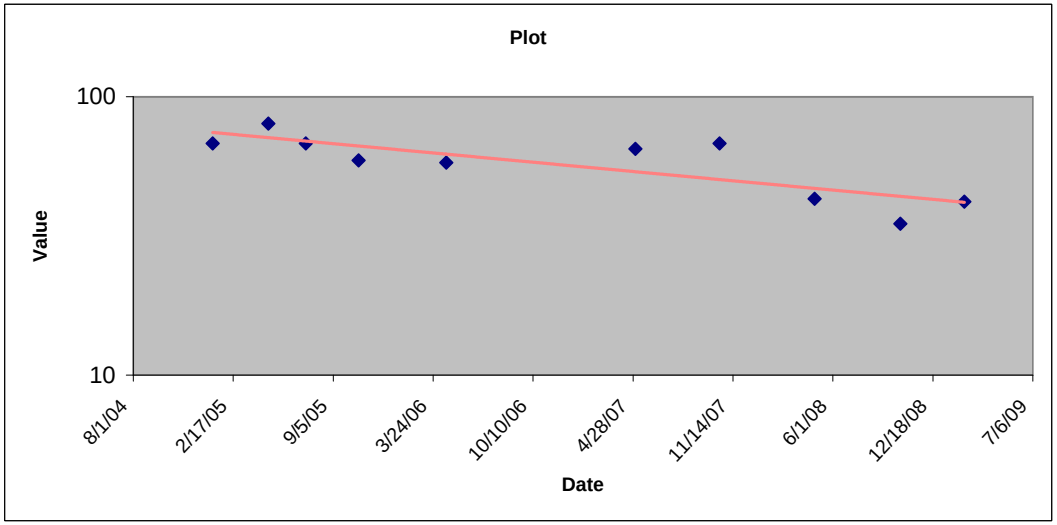
Attachment 5

Statistical Evaluations of EWL Eastern Lobe RDX
Since Second Five-Year Review

Mann-Kendall Non-Parametric Test for Trend
Well Monitoring Data Since 2004 Five-Year Review

Well ID	4-25	Potential Trend Direction	Decreasing	Z 90% Confindence Interval	1.645	90% Confidence Trend?	Yes	Arithmetic Mean	58.60
Sample Size (n)	10	Variance(S)	125	Z 95% Confindence Interval	1.96	95% Confidence Trend?	Yes	Standard Deviation	14.30
M-K Stat (S)	-28	Z	-2.415			If No Trend, Is Data Stable?	Yes	Coefficient of Variation	0.24

		J-flagged				rdx in blank														
Date	1/7/05	4/28/05	7/12/05	10/26/05	4/19/06	5/3/07	10/18/07	4/25/08	10/14/08	2/19/09										
Value	68	80	68	59	58	65	68	43	35	42										
	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	
		1	0	-1	-1	-1	0	-1	-1	-1										
			-1	-1	-1	-1	-1	-1	-1	-1										
				-1	-1	-1	0	-1	-1	-1										
					-1	1	1	-1	-1	-1										
						1	1	-1	-1	-1										
							1	-1	-1	-1										
								-1	-1	-1										
									-1	-1										
										1										



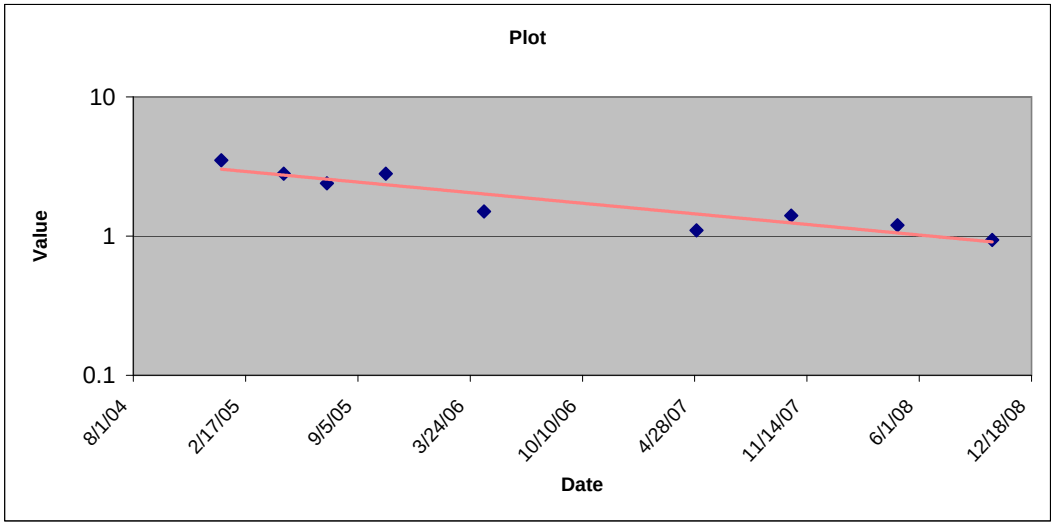
PNT ON	OFF	OFF	ON	ON
2/19/09	3/31/09	5/5/09	8/15/09	8/19/09
42	47	51	50	50
INCL. ABOVE				

PLANT OFF 2/20/09 UNTIL 8/14/09

Mann-Kendall Non-Parametric Test for Trend
Well Monitoring Data Since 2004 Five-Year Review

Well ID	4-121	Potential Trend Direction	Decreasing	Z 90% Confindence Interval	1.645	90% Confidence Trend?	Yes	Arithmetic Mean	1.96
Sample Size (n)	9	Variance(S)	92	Z 95% Confindence Interval	1.96	95% Confidence Trend?	Yes	Standard Deviation	0.93
M-K Stat (S)	-29	Z	-2.919			If No Trend, Is Data Stable?	Yes	Coefficient of Variation	0.47

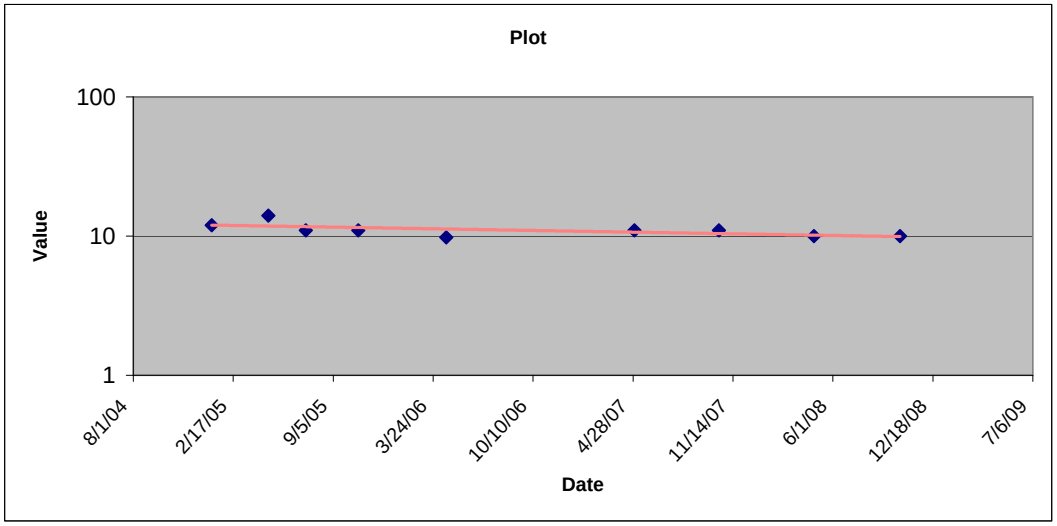
		J-flagged							
Date	1/5/05	4/26/05	7/12/05	10/25/05	4/18/06	5/1/07	10/17/07	4/23/08	10/9/08
Value	3.5	2.8	2.4	2.8	1.5	1.1	1.4	1.2	0.94
		-1	-1	-1	-1	-1	-1	-1	-1
			-1	0	-1	-1	-1	-1	-1
				1	-1	-1	-1	-1	-1
					-1	-1	-1	-1	-1
						-1	-1	-1	-1
							1	1	-1
								-1	-1
									-1



Mann-Kendall Non-Parametric Test for Trend
Well Monitoring Data Since 2004 Five-Year Review

Well ID	4-119	Potential Trend Direction	Decreasing	Z 90% Confindence Interval	1.645	90% Confidence Trend?	Yes	Arithmetic Mean	11.09
Sample Size (n)	9	Variance(S)	92	Z 95% Confindence Interval	1.96	95% Confidence Trend?	No	Standard Deviation	1.29
M-K Stat (S)	-19	Z	-1.877			If No Trend, Is Data Stable?	Yes	Coefficient of Variation	0.12

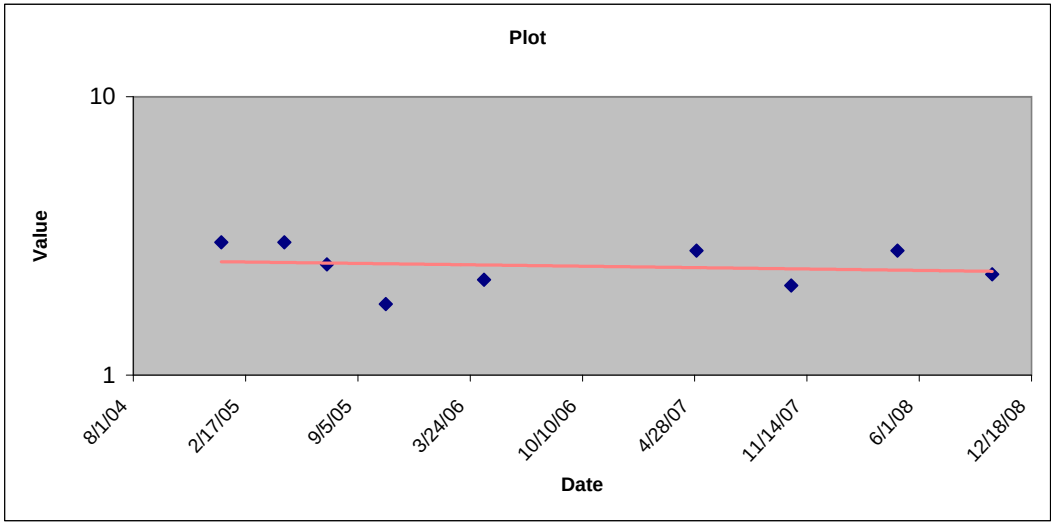
		J-flagged			rdx in blank															
Date	1/5/05	4/28/05	7/12/05	10/25/05	4/19/06	5/1/07	10/17/07	4/24/08	10/13/08											
Value	12	14	11	11	9.8	11	11	10	10											
		1	-1	-1	-1	-1	-1	-1	-1											
			-1	-1	-1	-1	-1	-1	-1											
				0	-1	0	0	-1	-1											
					-1	0	0	-1	-1											
						1	1	1	1											
							0	-1	-1											
								-1	-1											
									0											



Mann-Kendall Non-Parametric Test for Trend
Well Monitoring Data Since 2004 Five-Year Review

Well ID	4-122	Potential Trend Direction	Decreasing	Z 90% Confindence Interval	1.645	90% Confidence Trend?	No	Arithmetic Mean	2.50
Sample Size (n)	9	Variance(S)	92	Z 95% Confindence Interval	1.96	95% Confidence Trend?	No	Standard Deviation	0.43
M-K Stat (S)	-10	Z	-0.938			If No Trend, Is Data Stable?	Yes	Coefficient of Variation	0.17

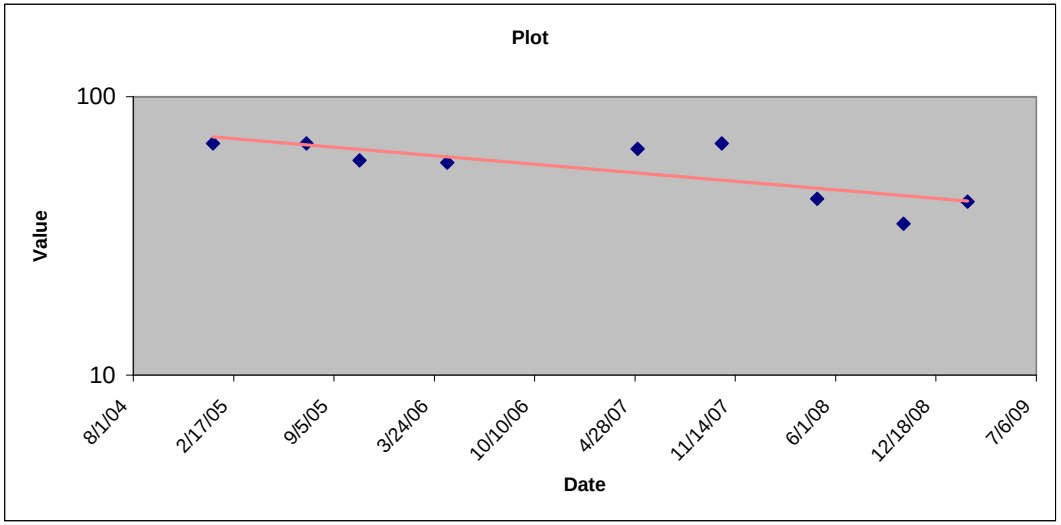
Date	1/5/05	4/27/05	7/12/05	10/25/05	4/18/06	5/1/07	10/17/07	4/23/08	10/9/08										
Value	3	3	2.5	1.8	2.2	2.8	2.1	2.8	2.3										
	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
		0	-1	-1	-1	-1	-1	-1	-1										
			-1	-1	-1	-1	-1	-1	-1										
				-1	-1	1	-1	1	-1										
					1	1	1	1	1										
						1	-1	1	1										
							-1	0	-1										
								1	1										
									-1										



Mann-Kendall Non-Parametric Test for Trend
Well Monitoring Data Since 2004 Five-Year Review

Well ID	4-25	Potential Trend Direction	Decreasing	Z 90% Confindence Interval	1.645	90% Confidence Trend?	Yes	Arithmetic Mean	56.22
Sample Size (n)	9	Variance(S)	92	Z 95% Confindence Interval	1.96	95% Confidence Trend?	Yes	Standard Deviation	12.90
M-K Stat (S)	-21	Z	-2.085			If No Trend, Is Data Stable?	Yes	Coefficient of Variation	0.23

		J-flagged			rdx in blank															
Date	1/7/05	7/12/05	10/26/05	4/19/06	5/3/07	10/18/07	4/25/08	10/14/08	2/19/09											
Value	68	68	59	58	65	68	43	35	42											
	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
		0	-1	-1	-1	0	-1	-1	-1											
			-1	-1	-1	0	-1	-1	-1											
				-1	1	1	-1	-1	-1											
					1	1	-1	-1	-1											
						1	-1	-1	-1											
							-1	-1	-1											
								-1	-1											
									1											



PNT ON	OFF	OFF	ON	ON
2/19/09	3/31/09	5/5/09	8/15/09	8/19/09
42	47	51	50	50
INCL. ABOVE				

PLANT OFF 2/20/09 UNTIL 8/14/09